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DEVELOPMENT COMPLETION OF A DATA BASE
MANAGEMENT SYSTEM PERFORMANCE MONITOR
VOLUME I

THESIS

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Captain, USAF

AFIT/GCS/ENG/85D-17

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VOLUME I

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology
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In Partial Fulfillment of the
Master of Science in Information Systems

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Preface

The purpose of this study was to complete the development of a data base management system performance monitor. This study presents the System Requirements, System Analysis, System Design and Implementation of a data base management system performance monitor. The emphasis of this study is on the completion of the performance monitor so that it may be applied as a comprehensive tool for the analysis of DBMS performance problems.

I would like to thank several individuals who were essential to my thesis efforts. Dr. Gary Lamont, my thesis advisor, and Dr. Thomas Hartrum, my thesis reader. I would also like to thank Mr. Bob Ewing for answering many of my questions, and my wife, Judy, and son, Andrew, for their support.

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Abstract

This study was concerned with the completion of a Data
Base Management System (DBMS) performance evaluation tool
named DBMON. The previously existing DBMS performance tool
was also developed at the AFIT Information Sciences
Laboratory.

The generalized design for a DBMS monitor was changed
to include the statistical and graphical analysis of
performance data, the maintenance of a performance report
library, and monitor operation with the INGRES DBMS. These
design features were then implemented into a new version of
the DBMON monitor.

A DBMON User's Methodolgy was developed and applied to
the diagnosis and correction of DBMS performance problems
using the DBMON system.

I. Introduction

Background

A Data Base Management System (DBMS) is a complex software
tool for the manipulation and maintenance of a computer data
base. The benefits of using a DBMS are numerous (7:9-12),
but come at the expense of the overhead placed on computer
resources. It is natural to want to maximize the benefits
and minimize the overhead incurred by the use of a DBMS.

In order to measure and identify areas where reductions
to DBMS overhead can be made, a DBMS performance monitor
called DBMON has been developed (2;5). This monitor is a
much needed tool, that has been designed to free Data Base
Administrators (DBA) from having to rely on intuition, and
trial and error techniques for improving DBMS performance.

Performance monitors can be grouped into one of three
categories (16:82-108): software, hardware, or hybrid.
This study concerns itself with the continued development of
a software based performance monitor with special emphasis
on DBMSs.

The thesis "Development of a Data Base Management
System Performance Monitor" documents the design of a data
base performance monitor which could collect and display
data base performance information (2). Work on this
performance monitor was continued in "Continued Development
of a Data Base Management System Performance Monitor" (5).

This second thesis effort continued development of the DBA's interface and measurement data analysis capability. This interface and the analysis capability allow the analysis and evaluation of DBMS performance.

The development of a DBMS performance monitor is an objective of the AFIT Information Sciences Laboratory (ISL). DBMON is part of an ongoing research development of a software engineering environment that will include DBMS applications and analysis.

Problem

The situation with the previously developed DBMS performance monitor (DBMON Version 2.0) is that it was an incomplete tool. A tool that lacked a complete user's methodology. A systematic approach to using the monitor in solving DBMS performance problems was required. Another limitation of DBMON was that its interface was restricted to use on the TOTAL DBMS. An extension of the monitors capabilities to include operation with other DBMSs was required to make DBMON useful in more applications. The third area that was lacking with the previously developed monitor, was the need to complete the development of the user interface in order to make DBMON a more complete, informative and easy to use tool.

Purpose

The purpose of this study is threefold.

1. Develop a user's methodology for the application of DBMON.

2. Adapt DBMON for use with other DBMSs.

3. Complete development of the user interface.

   a. Allow for the graphical representation of performace data.

   b. Allow for statistical analysis of performance data.

   c. Allow for DBMS maintenance of historical performace data.

Scope

The primary intention of this study was to complete the development of DBMON. The study does not provide a comprehensive analysis of all possible applications of DBMON, but does address the general methodology whereby DBMON may be applied to the analysis of performance problems.

Assumptions

1. DBMON, the previously developed performance monitor, is assumed to function correctly.

2. The VAX 11/780 computer system and its VMS operating are assumed to operate properly and provide accurate system

resource measurements.

3. The TOTAL and any other DBMSs used will remain operational for the testing of the performance monitor.

4. Any graphical and statistical packages used are assumed to work properly.

Standards

AFIT/ENG standards (1) of software engineering have been adhered to in the requirement, design, implementation, and testing phases of the project. Structured Analysis and Design Technique (SADT) Data Diagrams (15), and structure charts were used in order to provide graphical documentation of the design process. SADT Data Diagrams are an effective method of documenting the functional analysis and system design. Structure charts are used to clearly document the general program design. Data Dictionaries are used in support of the SADTs and Structure Charts. The documentation used follows the standards established by AFIT/ENG (1).

Approach

The approach used in this project consisted of the following six steps.

1. Familiarization with the existing system and software:

    a. VAX 11/780 computer system

    b. VMS operating system

    c. TOTAL and INGRES DBMSs

    d. DBMON

2. Literature review of the following areas:

    a. Graphical and statistical evaluation of data

    b. DBMS performance evaluation

3. System design

    a. Requirements definition

    b. Design of DBMON expansion

    c. Design of a user's performance evaluation
    methodology

    d. Define test objectives

    e. Document design process

4. System implmentation

    a. Code changes and additions to DBMON

    b. Test and validate the implmentation

    . Document implementation and testing process

.. system analysis and testing

    . Validate system

    . analyze a DBMS performance evaluation methodology

6. Documentation

    a. Compile all documentation

    b. Apply current software engineering principles and standards

Equipment and Software Required

This study required the use of the VAX 11/780 computer that is located in the AFIT Information Sciences Laboratory. All the required software was residing on this computer during the course of this study. The software includes the VAX VMS operating system, VMS utilities, and Data Base Management Systems.

Sequence of Presentation

Chapter II contains the functional requirements of DBMON, and an analysis of a user's data base performance evaluation methodology. Chapter III contains the system design of the improvements and extensions made to DBMON. Chapter IV documents the implementation and testing of DBMON on the VAX 11/780 computer running under the VMS operating system. Chapter V discusses the results, conclusions, and recommendations of this study.

II. System Analysis and Requirements

Introduction

This chapter presents the system analysis and requirements definition for the parts of the user interface that were not completed by the previous DBMON development efforts (2;5). Specifically, this consists of the statistical analysis function, the graphical presentation of performance data, and the maintenance of historical performance data. This chapter also considers the requirements of expanding DBMON to function with DBMSs other than TOTAL. The functional requirements of the expanded user interface are presented and integrated into the previously existing (5) requirements of a DBMS performance monitor. In addition, a DBMON user's methodology is discussed.

Background on the DBMON System

DBMON has been developed at AFIT/ENG to collect and analyze DBMS performance data in an effort to understand and improve DBMS performance. DBMON operates by using performance measurement and collection software that is embedded into DBMS application programs. DBMON allows the user to establish a monitor session, during which computer system statistics are recorded and DBMS applications programs are executed. The embedded DBMON software records

DBMS performance data during the execution of DBMS Data
Manipulation Language (DML) statements (7:21). Once the
monitor ses ion is completed, the collected data is analyzed
and can be veiwed by the DBMON user. This monitor system
has been designed and implemented on the VAX 11/780 computer
at the AFIT Information Sciences Laboratory.

The structure of DBMON consists of four main functional
areas as shown in Figure II-1. The four functional areas
are:

1. User Interface - This section allows the DBMON user to
specify performance parameters to be measured, duration of
the monitor session, and types of data presentation.

2. Measurement of System and DBMS - This portion of
DBMON controls the execution of the monitor program and
collects performance data.

3. Analyze Performance Measurement Data - This section is
to perform mathematical and statistical analysis of
performance data.

4. Present Performance Data to the User - This section
presents the collected and analyzed performance data to
the DBMON user.
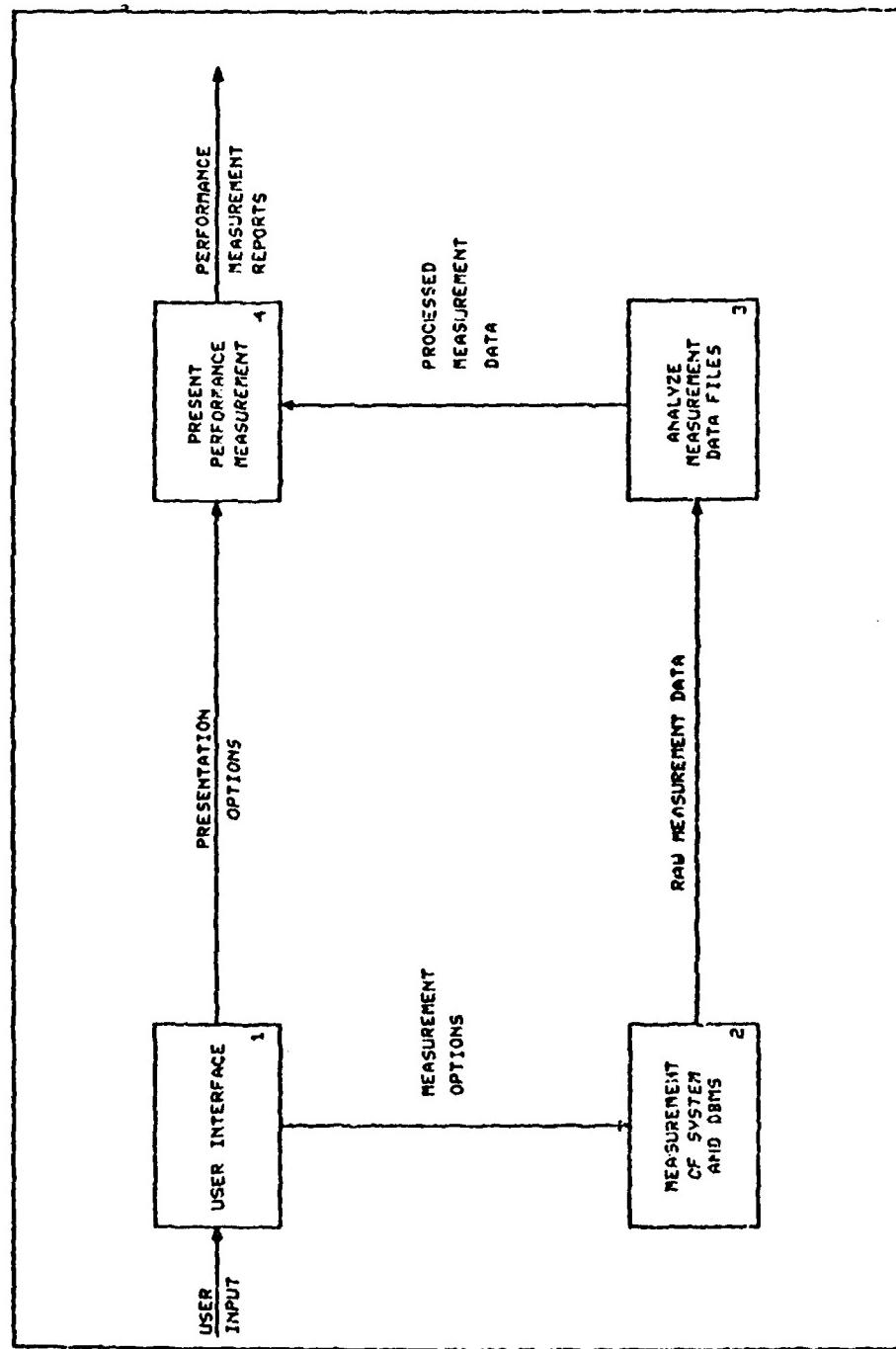
FIGURE II-1 DBMON BLOCK DIAGRAM

SOURCE (2:II-3)

This study addresses enhancements to all four DBMON functioanl areas. Areas one and two are affected by the adaption of DBMON to function with more than one DBMS. Area three is concerned with the statistical and graphical analysis of performance data. Graphical and historical data presentation are a portion of area four.

Adaption of DBMON to Other DBMSs

The usefulness of any tool can be maximized when it can be applied to a wide variety of applications. Therefore the rationale of expanding DBMON to work with other DBMSs is to make DBMON a more useful tool by expanding its applicability.

The functional requirements of DBMS performance measurement can be directly applied from previous work (2) with the TOTAL DBMS. Chapter II of the thesis "Development of a DBMS Performance Monitor" (2) extensively discusses the initial requirements and system analysis of the measurement of a DBMS.

Briefly, the measurement of a DBMS includes the consideration of performance parameters that reflect upon the effectiveness and efficiency of the DBMS. This involves the measurement of the host computer's workload and the effect of DBMS operations upon the host computer. Appendix C of the above mentioned thesis contains a comprehensive set of DBMS performance measurement parameters.

II-4

Developing a unified DBMS performance monitor can be
accomplished by directly applying the functional
requirements and system design from the previously developed
DBMON. Maintaining one set of requirements for all the
DBMSs that DBMON can be used with, minimizes the amount of
special case processing that is required by a DBMON user who
applies this tool to TOTAL and other DBMSs. It is possible,
however, that some unique features of a particular DBMS will
not be able to be measured directly or easily because of the
use of a more general data base performance monitor.
However, the advantage of using a more general and widely
applicable tool outweigh any occasional inconvenience.

Statistical Analysis of DBMS Performance Data

The need for statistical analysis (data reduction) of
DBMS performance data becomes apparent when one is
confronted by a mass of performance data. The requirement
here is to analyze the data and reach a conclusion as to the
data's significance. The obvious solution of the data
analysis problem is to apply statistical techniques in order
to be able to make an inference as to the significance of
performance testing. Statistical data reduction can bring
the mass of performance data into a manageable form.

A difficulty arises at this point in deciding what
quantatative methodology should be applied in order to
evaluate DBMS performance. Quantitative methods can be

II-5

A problem that arises is the very large number of factors and their complex interrelationships. Even worse are factors that affect the experimentation but cannot be effectively controlled. An instance is the effect of a computer's workload during the time of testing. Any experimental design should concern itself with extraneous factors like system workload.

The factorial experiment is most useful in the computer performance environment (13:18). This type of performance testing evaluates all combinations of the factors under study in an effort to uncover the interactions between the factors. Analysis of variance is a technique that can be very useful in evaluating statistical data. This technique will allow estimation of the effects and determine which of the effects that were measured are important.

If a factorial statistical test is not available, pairwise comparisons of two groups of sample data can be done. If more than one factor is being considered, then multiple pairwise comparisons can be used to detect which factor or combination of factors has a significant effect. This technique can circumvent the unavailability of a fully factorial statistical test.

The statistical processing module of DBMON needs to take the collected performance data and perform user requested statistical calculations that will indicate the presence or absence of any statistical difference between

DBMS performance measurement data sets. The results of the
statistical analysis need to be displayed on the video
terminal and/or printed on the system printer in order to be
evaluated by the DBMON user.

Graphical Presentation of Performance Data

Graphical presentation of a large amount of numerical
data is the simplest method of portraying a trend within a
large body of data. DBMON is capable of producing a vast
amount of raw numerical data that cannot be evaluated by
simply scanning the numbers. An obvious solution is to
convert the raw performance data into graphical
presentations showing the distribution of the performance
parameter that is being examined.

There are six general methods of representing
performance data to the DBMON user (5:II-10).

1. Lists - lists of performance data.

2. Graphs - graphical information display.

3. Tables - organized lists with headings and totals.

4. Plots - plotted performance data.

5. Charts - Gantt charts, pie charts, and histograms.

6. Reports - custom made reports of DBMS performance

data.

DBMON already has implemented the use of lists, tables, and
custom reports. What is required to further improve the
presentation of performance data to the user is the use of
graphs and charts. This will allow the quick interpretation
of general trends that is not possible by examining the
reports of numerical data. The "simplest" method applicable
here is the use of the histogram. Histograms are easily
constructed and meet the requirement of presenting data
trends. Plots may be used, but they are more complex than
histograms.

The DBMON graphical presentation module should allow
the display of any of the performance measures that are
collected by DBMON. For maximum utility the graphical
presentation should displayed at the video terminal and at
the system printer at the request of the DBMON user.

Historical Maintenance of Performance Data

Over a long period of time a large amount of DBMS
performance data can be collected. What is needed is a
method of maintaining an index of performance tests that
will allow the maintenance of benchmark evaluations.
Maintaining benchmarks is required for the testing of
differnces due to a change in DBMS processing over a period
of time.

In essence, what is required is a library management
system that uses a DBMS for maintaining a library of

performance test data. The user needs to be able to store
performance reports into a library and retrieve the data
when needed. The performance data could be identified by
the collection date, or some other means of identification.
This library of benchmarks can be used as needed as
references to previous performance states of the DBMS being
studied. For further discussion of DBMS performance
benchmarks see reference 4.

Analysis of a DBMS Performance Methodology

Methodology can be defined as the synthesis of methods
and tools. The Tool in the case of this study is the DBMON
system. DBMON and the methods of its application comprise a
DBMON user's methodolgy as shown in Figure II-2 (A similar
performance improvement procedure is discussed in reference
(3)). A method for analyzing DBMS performance can consist
of the following five phases:

1. Understand the System - This phase involves
familiarization with the computer system, the DBMS, and
the DBMS application being studied.
2. Identify Problem Areas - This phase involves analyzing
the use of a DBMS to identify any potential problem areas
that need to be addressed. This phase could also involve
making and storing benchmark measurements against which to
guage any future performance degredations.

3. Formulate a Performance Improvement Hypothesis - Once familiar with the system, and having identified a problem area, possible performance improvement hypothsis can be listed. These hypothesis should be analyzed to see if they are feasible. Unrealistic solutions to performace problems can be rejected at this stage.

4. Test Performance Improvements - This stage involves the design, implementation, and analysis of an experiment. The hypothesis from phase four can be implemented and statistically evaluated against the benchmark testing from phase two.

5. Implement Performance Improvement Modifications - The statistical evaluation of phase four should indicate the most effective modifications that can be made. In this phase, the modifications should be installed and validated for effectiveness and efficiency.

The DBMON User's Methodolgy is further described in Appendix E, the DBMON User's Guide. The User's Guide discusses the practical application of the DBMON User's Methodology to solving DBMS performance problems with the DBMON performance monitor.

Figure II-2 DBMON USER'S METHODOLOGY

The diagram contains the following boxes:

- UNDERSTAND SYSTEM (1)
- IDENTIFY PROBLEM AREAS (2)
- FORMULATE IMPROVEMENT HYPOTHESIS (3)
- TEST PERFORMANCE IMPROVEMENT (4)
- IMPLEMENT PERFORMANCE IMPROVEMENT (5)
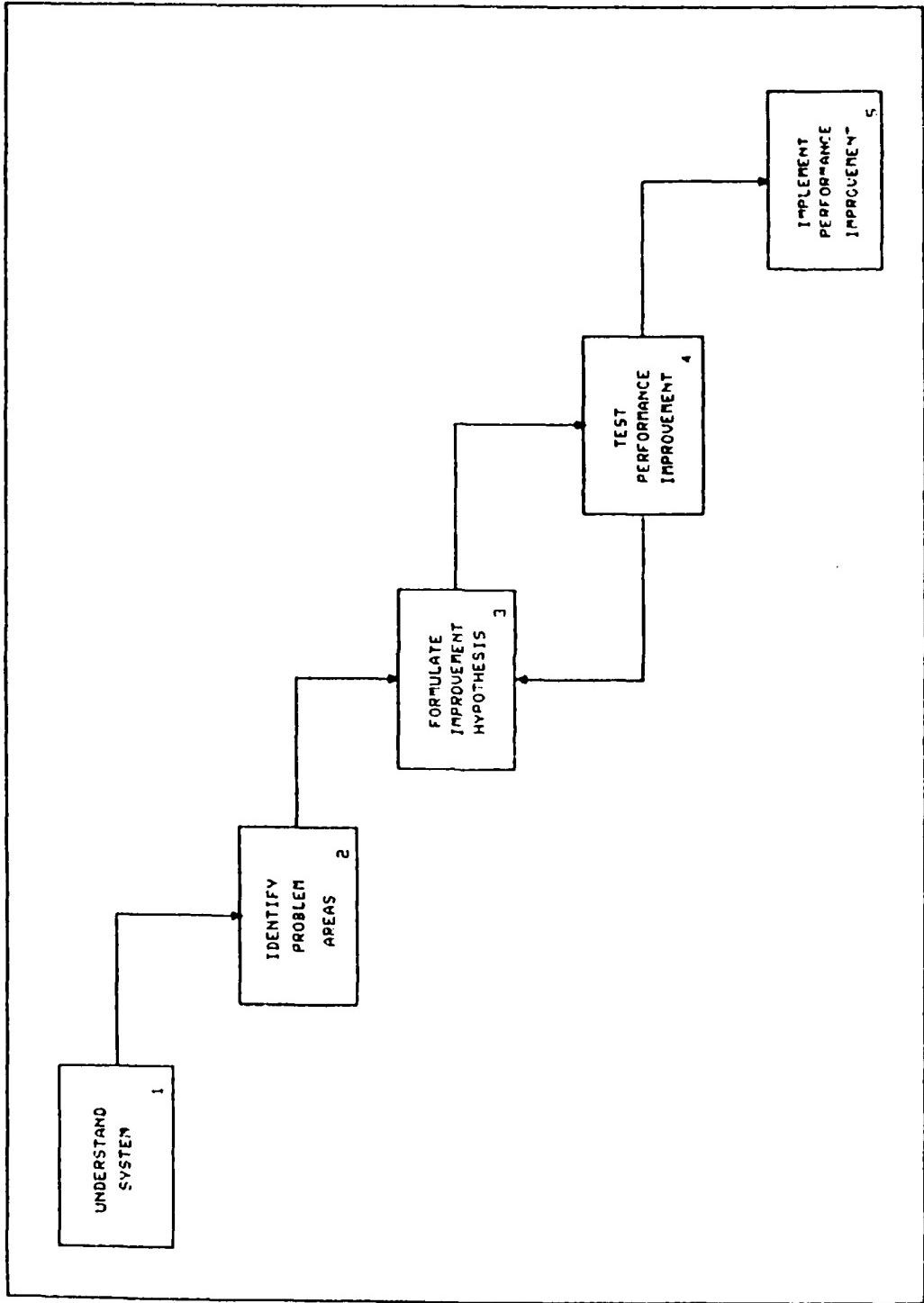
Summary

     This chapter presented the general system analysis and
functional requirements for the DBMON DBMS performance
monitor. The following components of DBMON development
completion were discussed:

   1.   DBMON adaption to DBMSs other than TOTAL

   2.   Statistical analysis of performance data

   3.   Graphical presentation of performance data

   4.   Maintenance of historical performance data

Functional requirements of the above components were listed
and incorporated into the general requirements of DBMON.
The current set of detailed functional requirements for the
DBMON system are presented in Appendix A.

     This chapter also discussed a DBMON User's Methodology.
This methodology was presented as an application of DBMON to
solving DBMS performance problems.

III. System Design

Introduction

This chapter presents the system design for the continuing development of DBMON. The revised functional requirements discussed in chapter II were used as objectives of the system design, and are addressed in the revised design.

This chapter addresses the system design documentation, descriptions of the design, and the test plan to be used in the implementation stage of development.

Design Documentation

The Structured Analysis and Design Technique (SADT) (15) was used to document the revised design of a DBMS performance monitor. The SADT technique was primarily used because it specifically shows the activities that the design must address. The use of SADTs is also in keeping with the previous two DBMON development efforts (2;5). Reference 15 may be consulted for the details of the use and interpretation of SADTs. The SADT documentation technique is also consistent with the documentation standards of AFIT/ENG (1).

This chapter addresses the additions and changes made to the previously existing design of a data base performance monitor. The complete set of SADT documentation for the

data base performance monitor is contained in Appendix B.
This set contains the entire system design developed in
previous work (2;5) along with the additions and changes
made during the course of this study. Appendix C contains
changes to the system test plan. Appendix D contains the
system design structure charts of the portions of the data
base performance monitor that were modified during the
course of this study.

Overall System Design Summary

The top level view of the DBMON system was presented in
Chapter II and illustrated by Figure II-1. Chapter III of
references 2 and 5 also discuss the overall system design.

As seen in Figure II-1, the data base performance
monitor can be separated into four functional areas. These
functional areas are:

(1) User Interface

(2) Measure System and DBMS

(3) Analyze Measurement Data Files

(4) Present Performance Measurement Data to User

The User Interface (see Figure B-3) controls the
operation of the performance monitor. It allows the DBMON
user to specify monitor options, initiate monitor operation,
and terminate monitor execution. The user interface uses

III-2

the monitor user's directives to build a set of performance

commands used to perform the DBMS and system measurement,

analyze the raw data, and display the analyzed measurement

data to the user.

The Measure System and DBMS functional area (see Figure

B-4) performs the actual system and DBMS measurements as

directed by commands from the User Interface. The Map

Performance Parameters to Measurement Source activity

relates the user requested measurement to the available

performance tools. The Create Performance Tool Commands or

Instructions activity creates the performance tool

instructions used to control performance tool operation.

The Create or Initialize Measurement Data Files activity

creates new data files or initializes existing files that

will be used to record performance data. The Activate

Performance Tools activity uses the tool commands to

activate and control the tool operation. The Connect

Performance Tool activity uses tool instructions to direct

human operation of any performance tools that require

operator intervention.

The Analyze Measurement Data Files activity (see Figure

B-5) combines the measurement data files produced by the

various performance tools into one measurement data file

that is formatted for presentation to the user. This

activity is controlled by user commands obtained by the User

Interface. The Perform Statistical and Graphical Analysis

activity takes the raw measurement data files and prepares
the data for statistical and/or graphical analysis. The
statistical and graphical analysis can be performed by a
statistical/graphical analysis package that provides the
requested analyzed data to the monitor user.

The Present Performance Measurement Data to User area
(see Figure B-6) presents the analyzed performance data to
the monitor user. The Create Performance Parameter Report
creates the performance parameter report from the analyzed
measurement data files. The Perform Library Management
activity allows monitor performance reports to be stored in
a library until deleted by the user. The Present
Performance Data to User activity displays the analyzed
measurement data, statistical analysis, and graphical
representation of performance data upon the terminal screen.

Adaption of DBMON to Use with Other DBMSs

The initial flexible design of DBMON allows for the use
of any DBMS with DBMON, so the system design changes only
slightly with regard to the use of another DBMS. Adapting
another DBMS to work with DBMON is primarily a matter of
implementation. Figure B-4 shows the Measure System and
DBMS SADT Activity Diagram. It is unchanged from the
previous system design (5). Figure D-7 shows the structure
chart of the Instrumentation Utility. In order to
accomodate more than one DBMS, the utility is now passed

the name of the DBMS that is to be measured. This allows
the utility to perform any special processing required for
the measured DBMS.

Design of the Statistical Analysis Function

The requirements of statistical analysis had been
initially addressed in previous DBMON development efforts
(2;5). The SADT activity diagram is represented in Figure
III-1. Structure charts are represented in Figures D-4 and
D-8. Statistical analysis is a part of the analysis process
that converts the raw performance data collected by the
monitor into a more useable form. Measurement Data Files
and Analyzed Measurement Data Files are formatted into
statistical analysis data that is analyzed under the user
direction in the Data Analysis Program.

The statistical analysis data is stored in a data file
structure. A data file structure is sufficient to store
statistical information for later sequential retrieval.
Additional data retrieval operations provided by other data
structures, such as linked lists, are not required for the
statistical analysis process. Each record in this file
includes the following information:

  (a) DBMS DML command identifier
  (b) DML performance data items
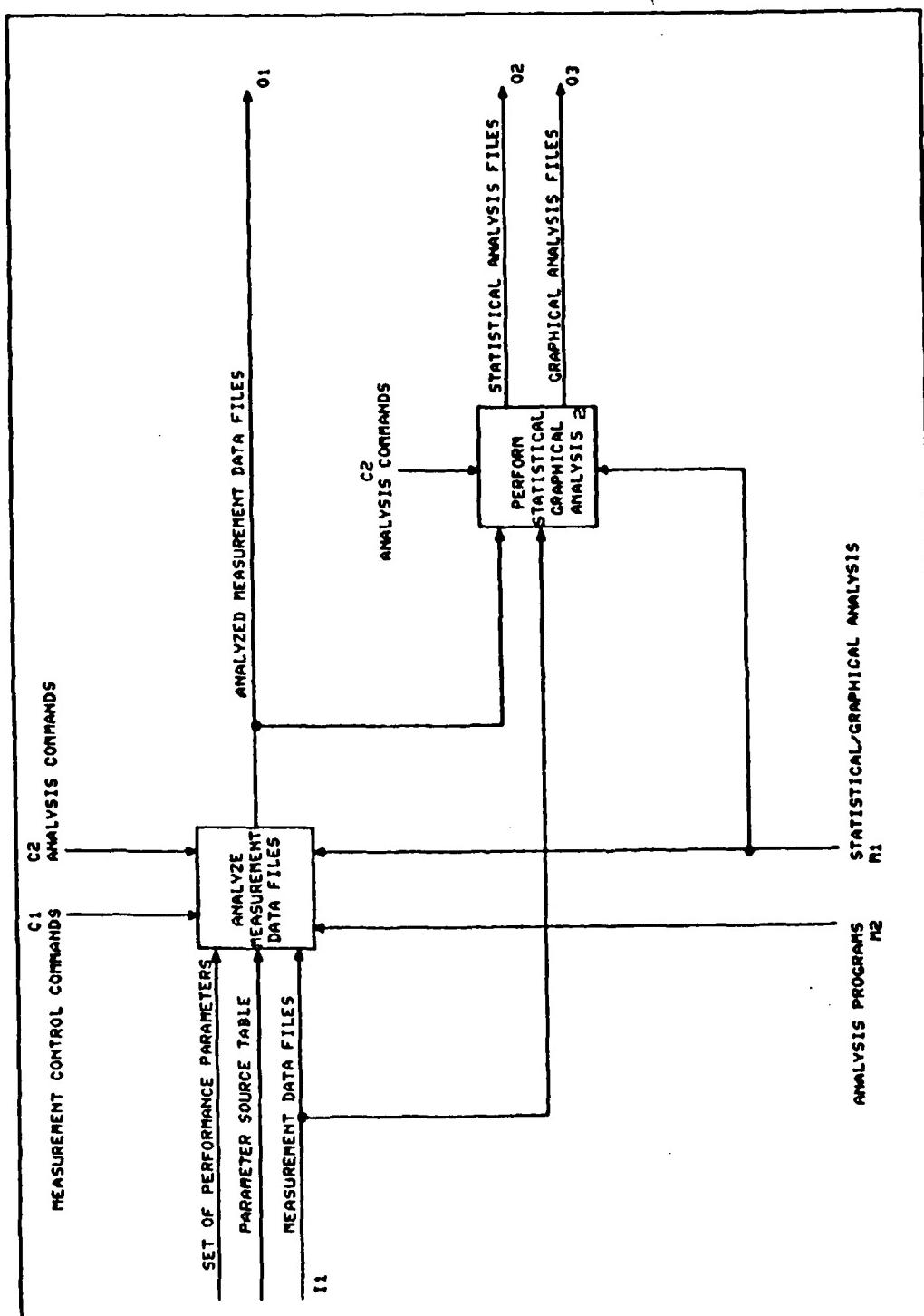
Figure III-1 ANALYZE MEASUREMENT DATA FILES SADT

The outputs of this activity are statistical analysis
displays that can be presented to the monitor user. The
Perform Statistical/Graphical Analysis Activity satisfies
functional requirement 3.2 in Appendix A.

Design of the Graphical Analysis Function

Graphical Analysis is a part of the Perform
Statistical/Graphical Analysis Activity shown in Figure
III-1. Structure charts are represented in Figures D-5 and
D-8. Graphical analysis design is conceptually closely
related to the statistical analysis. The data required for
both types of analysis are the same, and the software
packages needed to implement the analysis will relate
operationally to the DBMON design in similar ways.
Measurement Data Files and Analyzed Measurement Data Files
are formatted into graphical analysis files which are
analyzed under the direction of Analysis Commands from the
User Interface.

The graphical analysis data is stored in a data file
structure. As with the statistical analysis data structure,
a file structure is sufficient to store statistical
information for later sequential retrieval. Each record in
this file includes the following information:

(a) DBMS DML command identifier

(b) DML performance data items

The outputs of this activity are graphical analysis displays that can be presented to the monitor user. The Perform Statistical/Graphical Analysis Activity satisfies functional requirement 3.2 in Appendix A.

Design of Performance Report Library Function

Figure III-2 shows the SADT activity diagram for the Perform Library Management Activity. Structure charts are represented in Figure D-6. The design addresses the need of storing, retrieving, and deleting performance reports from a library. The Performance Parameter Report is input into the report library by the Store Report activity. Once stored, a report can be retrieved by the Retrieve Report activity for viewing or deleted when no longer required by the Delete Report activity.

This activity uses a file structure to store the index to the Report Library. Each record in this file contains the following information:

(a) Performance report identifier

(b) Report library file name
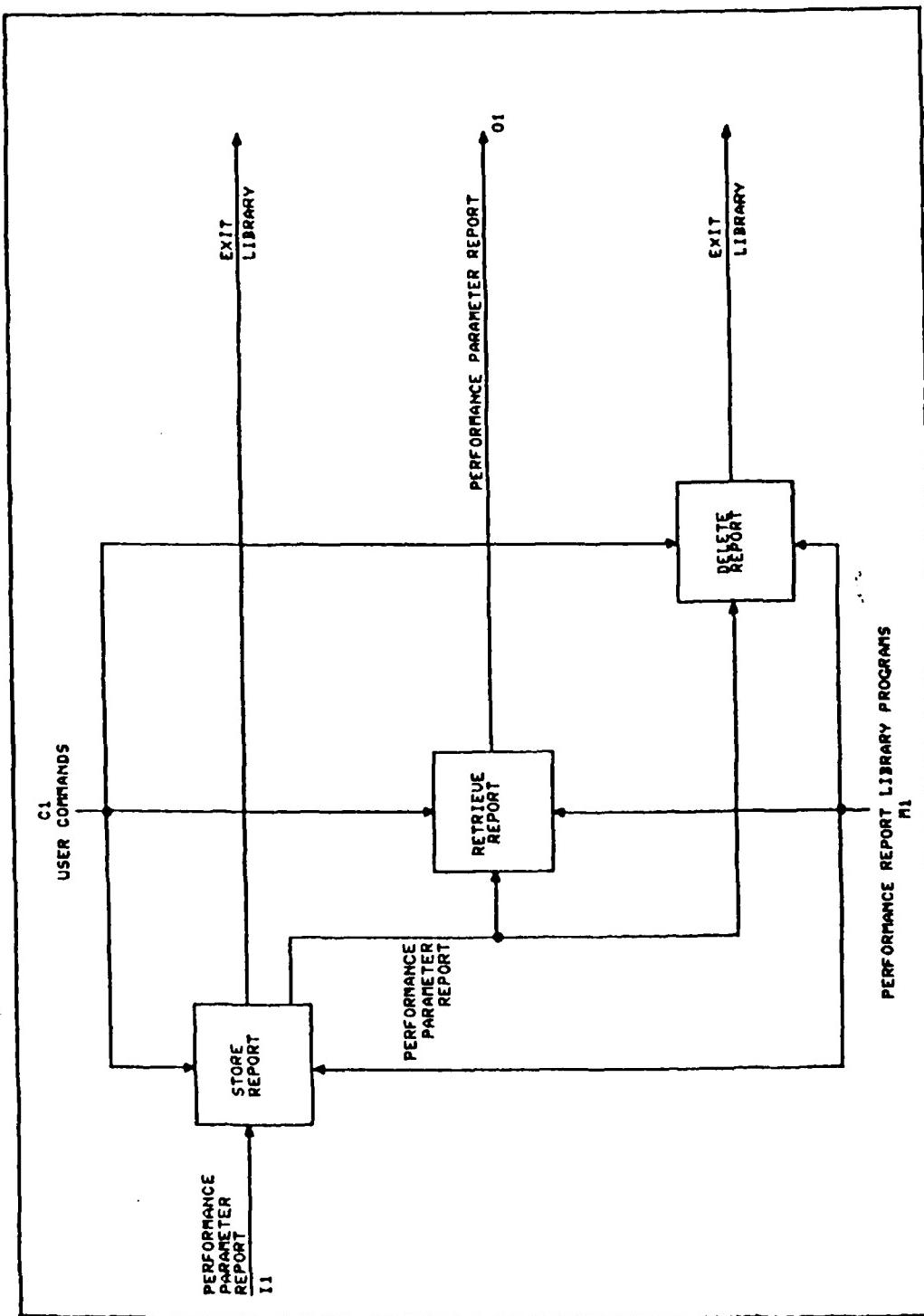
Figure III-2 PERFORM LIBRARY MANAGEMENT SADT

The Report Library uses this information to maintain an index to the contents of the library.

The Perform Library Management activity satisfies functional requirement 4.4 in Appendix A.

Test Plan

A formal test plan for the DBMS performance monitor has been developed and can be found in Appendix D (2). Each entry contains the functional requirement, specific test cases, expected results of the test cases, actual results, and a remarks section. This format is the same as used in reference (2). During this study several changes and additions were made to the functional requirements and system design. The additions and changes to the previously existing test plan (2) are contained in Appendix C.

Summary

This chapter presented the system design for the changes made to DBMON. The chapter discussed design documentation, overall system design, a description of changes to the previous design, and the changes to the previous DBMS performance monitor test plan. The SADT design documentation is contained in Appendix B. The additions to the performance monitor test plan are contained in Appendix C. Appendix D contains the structure charts for the system design changes.

IV. <u>System Implementation and Testing</u>

<u>Introduction</u>

This chapter presents the implementation and testing of
DBMON extensions. The chapter includes the implementation
plan, DBMS and programming language selection, development
computer configuration, discussion of DBMON extensions, and
general DBMON operation description. Appendix E contains
the detailed DBMON User's Guide. Appendix F contains the
test results.

<u>Implementation Plan</u>

The implementation of DBMON modifications discussed in
chapters II and III were undertaken with the following
steps:

1. Understand the VAX 11/780 computer system and VAX/VMS
operating system.

2. Understand the use and operation of the previously
existing version of DBMON.

3. Understand the use and operation of the INGRES DBMS.

4. Modify the Instrumentation Utility to allow the INGRES
DBMS to be measured. Document the modifications with
structure charts and commented code. This step relates to
functional requirement 2.1.

5. Modify the Data Analysis Program to allow it to
function with INGRES performance measurement data.

Document the modifications with structure charts and commented code. This step relates to functional requirement 3.1.1.

6. Modify the Data Analysis program to allow it to produce statistical and graphical data files. Document the modifications with structure charts and commented code. This step relates to functional requirements 3.0.

7. Modify the DBMON program to allow graphical display of performance measurement data. Document the modifications with structure charts and commented code. This step relates to functional requirement 4.3.

8. Modify the DBMON program to allow statistical analysis to be performed and displayed. Document the modifications with structure charts and commented code. This step relates to functional requirement 3.2.

9. Modify the DBMON program menus to include an online help feature to display information about DBMON menus. Document the modifications with commented code. This step relates to functional requirement 5.0.

Development Computer Configuration

DBMON has been implemented on the Digital Equipment Corporation (DEC) VAX 11/780 (10) located in the AFIT/EN Information Sciences Laboratory. This computer system is primarily used to conduct research, but is also used in limited classroom support. A representation of the hardware configuration is shown in Figure IV-1.
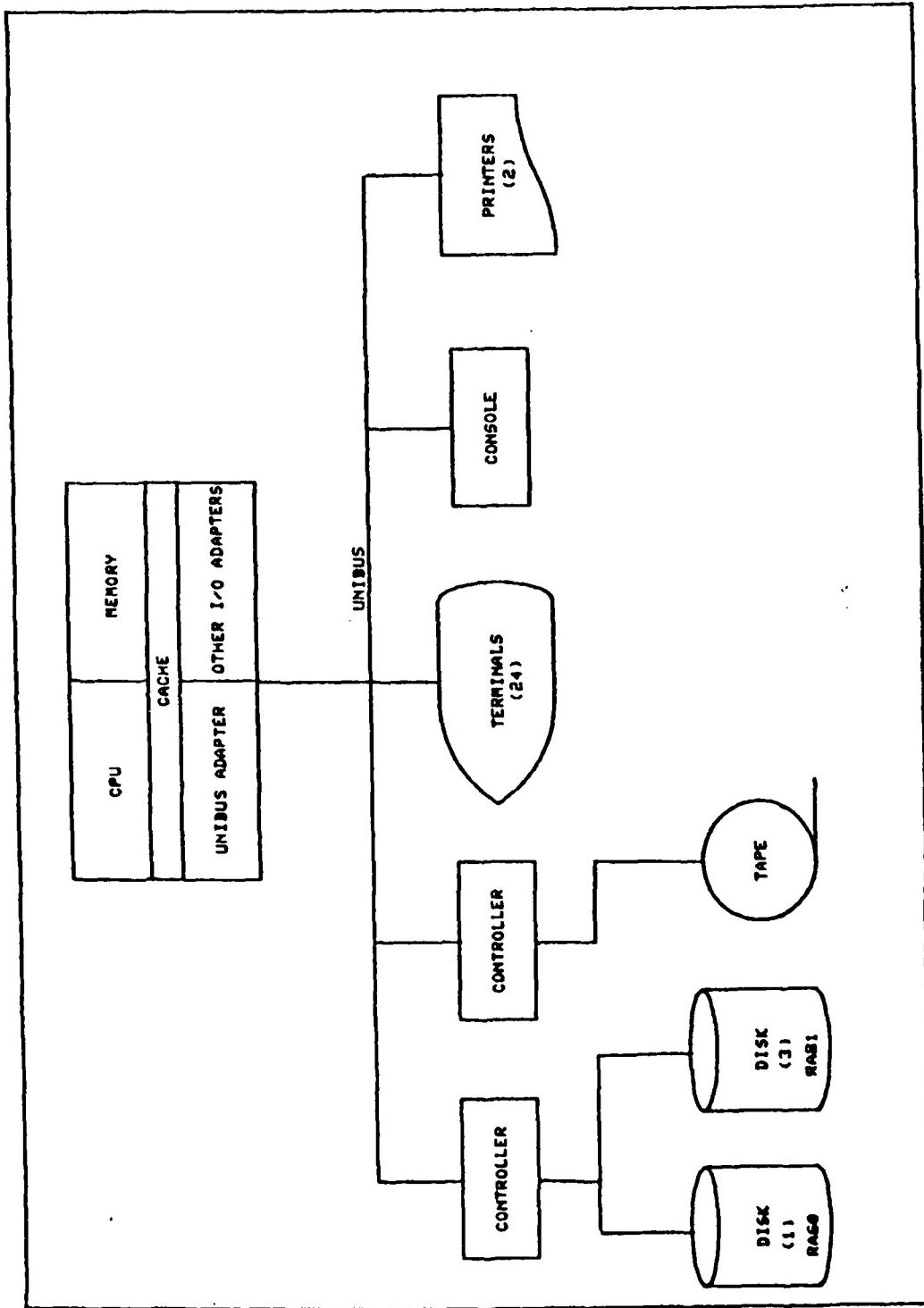
Figure IV-1 VAX 11/780 HARDWARE CONFIGURATION

Selection of DBMS and Programming Language

DBMON's interface to the INGRES DBMS (14) was
implemented during the course of this study. INGRES was
selected for two major reasons. First, it was readily
availible for use on the ISL VAX 11/780 computer system.
Second, by being a relational DBMS, INGRES provides an
interesting contrast to the TOTAL (6) DBMS, a network type
DBMS, that was previously interfaced with DBMON. An
alternative was DEC's Datatrieve (9). Datatrieve, however,
is another network type DBMS. The contrast with TOTAL would
not have been as great as the contrast with INGRES.

The programming language selected for implementation
was VAX/VMS Pascal (11). The rationale was simply to remain
consistent with the previous versions of DBMON. It would be
an unreasonable complication to use another programming
language for the modifications to DBMON, and a duplication
of effort to rewrite the entire system in another language.

The instrumentation utility is the only portion of the
DBMON system not written in Pascal. This utility is written
in VAX Macro Assembly Language (12). This utility was
originally written in Macro because of Pascal's limited
ability to interact with the VAX File System and System
Services Library (2:V-6). For the same reasons as the
Pascal language selection, the use of Macro Asembly Language
was maintained for the Instrumentation Utility.

Software Implmentation of the INGRES Adaption to DBMON

Several changes were made to the previously existing version of DBMON (5) in order to allow the monitoring of the INGRES DBMS. The Instrument Utility was changed so that it could measure either TOTAL or INGRES operation (see Figure D-7). This was needed in order to interface INGRES to DBMON. The DBMS application program that calls the Instrument Utility now passes the name of the DBMS that is being accessed. The Instrument Utility uses this information to identify the target DBMS running on the computer system and perform system measurements accordingly. There was no change from the previous versions of DBMON (2;5) in the type of data collected or the system tools used to collect the data. The previously defined measurement parameters were applied directly to the instrumentation of INGRES.

Another change performed to interface INGRES to DBMON was to the Data Analysis Program that analyzes the raw measurement data and produces the instrumentation report (see Figure D-8). Upon running this program, the user now specifies the name of the DBMS that produced the raw measurement data. Since TOTAL and INGRES use different DML commands, the Data Analysis Program must be directed as to which set of DML commands it is to work with in producing the instrumentation report.

Software Implmentation of the Report Library System

The Report Library was implemented as part of the DBMON
User Interface Program. The User Interface Program already
was able to display the current performance report; now the
library allows historical performance reports to be
maintained and retrieved when needed. The Report Library
Block Diagram for the library is shown in Figure IV-2. The
Library is reached by the user through the use of menu
directed commands, for details of operation see Appendix E.

The Report Library consists of two parts: an INGRES
data base of information about stored reports, and a VMS
sub-directory of the actual report files. The function of
the INGRES data base is to record a descriptive title and
the date of each stored report. By entering this
information along with the file name of the report to be
stored, the DBMON user can direct the Library to copy the
report file into the report sub-directory. The report
sub-directory is the actual repository of performance
reports. Once the reports are stored, the user can then
identify them uniquely by specifying the title and date,
thereby allowing retrievals of stored reports, and the
deletion of unwanted reports. A listing of the library
contents may "easily" be obtained by interactively directing
INGRES to list the library data base contents. This listing
is also available for viewing in the DBMON Interface
Program.

IV-6

REPORT
SUB-DIRECTORY

DBMON
USER INTERFACE
PROGRAM

REPORT
LIBRARY
MODULES

PERFORMANCE REPORTS

PERFORMANCE
REPORTS

INSTRUMENTATION
UTILITY
PROGRAM

INSTRUMENTATION REPORT

SYSTEM PARAMETER REPORT

PRTREPORT
PROGRAM
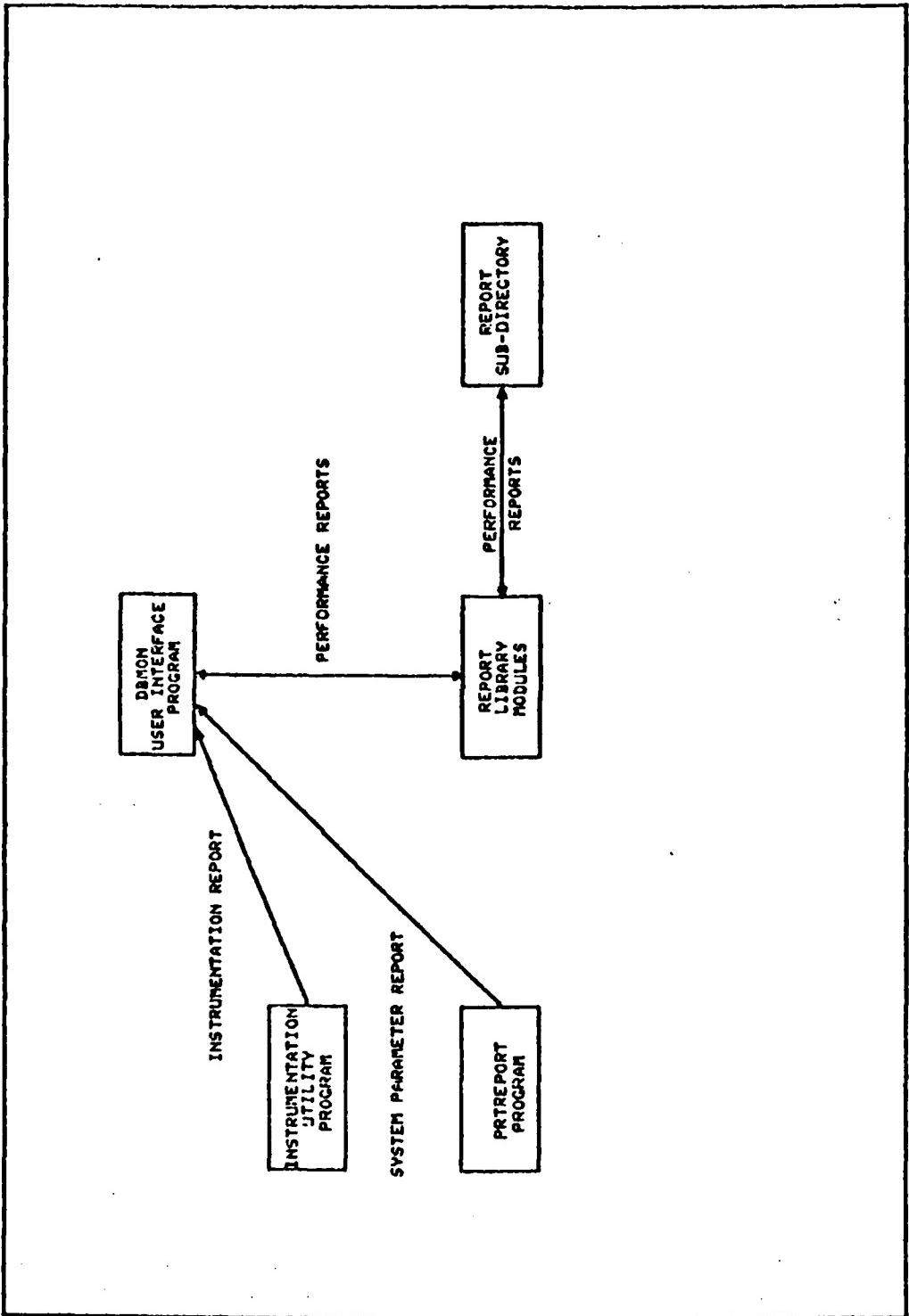
Figure IV-2 REPORT LIBRARY BLOCK DIAGRAM

IV-7

The alternative to this Report Library was to manually maintain a library of performance reports. The major benefit of the automated library is the automatically enforced recordkeeping that will keep reports from being misplaced or forgotten. A minor benefit is the ease of storage, retrieval, and deletion of reports.

Software Implmentation of the Graphical Measurement Data Display

The implementation of the graphical measurement display began with a modification of the Data Analysis Program. This program was made to produce an INGRES data base of the performance measurement data formatted to allow simple conversion into a bar graph display on the user's terminal (See Figure D-8). The relations of the data base are the following:

(1) DBMS DML command identifier

(2) DBMS performance parameter value

(3) Column position of the data value in the display graph.

The use of INGRES also allows easy adaption of the graphical analysis files for use with any future extension of DBMON graphical capability.

The graphical analysis is carried out in the DBMON User Interface Program as an extension of the existing capability to display performance measurements. This program uses VT100 terminal graphics to produce graphical performance data representations since VT100 terminals and VT100 compatible terminals (VT240) are available in the AFIT ISL. Other terminal types may be used after some modification to the DBMON graphics software modules (See Appendix E). The Block Diagram for the graphical analysis of performance data is presented in Figure IV-3.

The performance graphics produce a bar graph showing the relative frequency of the following instrumentation parameters broken into eight equally sized ranges of values.

(1) DML response times

(2) DML CPU usage times

(3) DML direct I/O count

(4) DML buffered I/O count

(5) DML page fault count

(6) DML working set size

Eight graph partitions were chosen as a compromise between screen readability and maximum spread of the performance data over the graph.
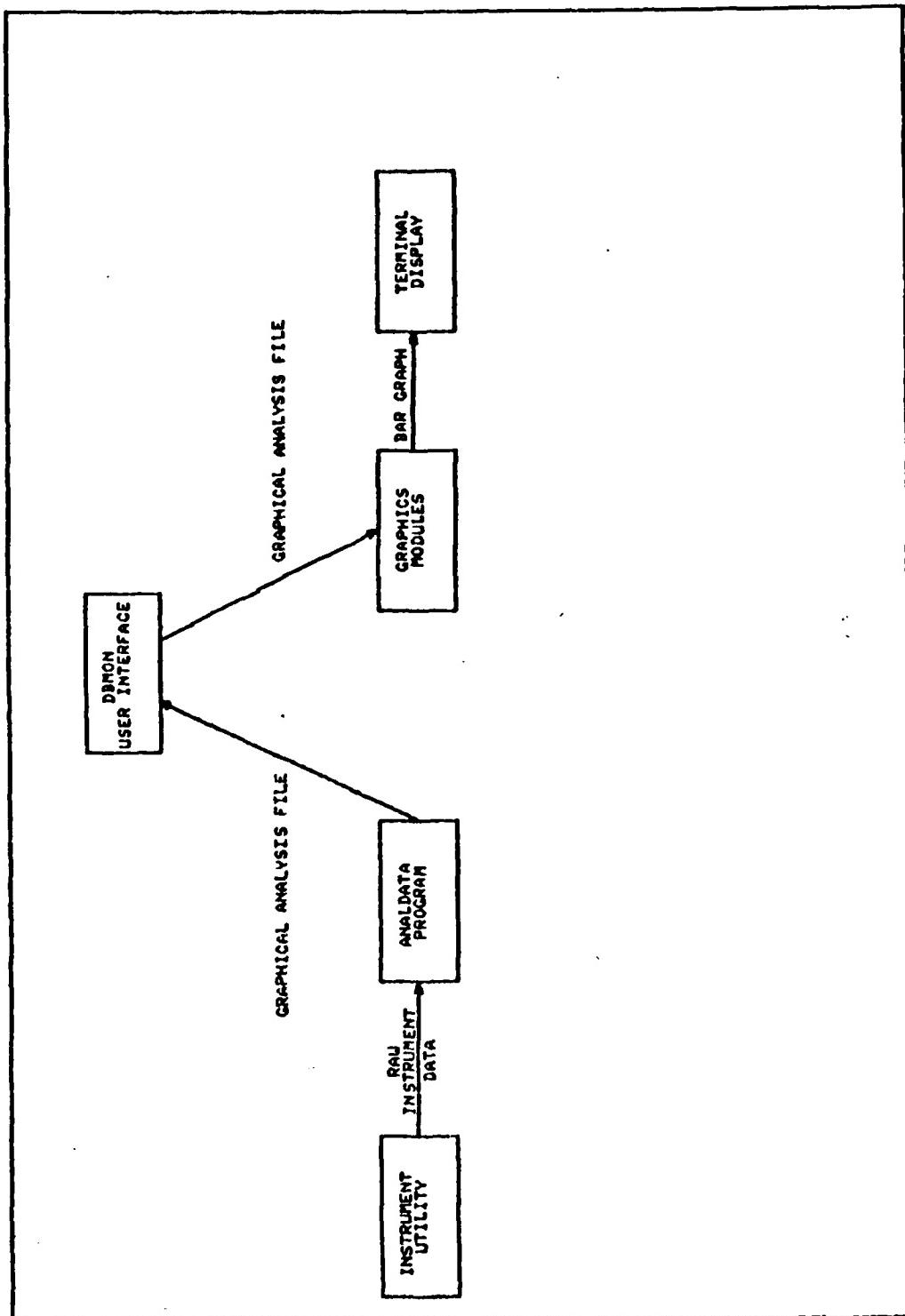
Figure IV-3 DBMON GRAPHICS BLOCK DIAGRAM

There are many alternatives to using a bar graph to represent performance data such as pie charts and scatter plots. Bar graphs were selected because of their greater simplicity, ease of understanding, and ease of implementation. The latter was important in the case of this study due to the unavailibility of a suitable graphical analysis package. Bar graphs satisfy the requirement of graphically portraying performance data in a way that can help identify trends in the data.

Software Implmentation of the Statistical Analysis of Performance Data

The Data Analysis Program that produces the graphical analysis files also produces the statistical analysis files. To produce a statistical analysis file the DBMON user must specify a name for the statistical file. This name will be required by the DBMON User Interface program in order to identify the correct statistical files that are to be compared. The statistical analysis file is also an INGRES data base. The relations of the data base are the following:

(1) DBMS DML command identifier

(2) DBMS performance parameter values

The use of INGRES simplifies any future extension of DBMON statistical capabilities. The Block Diagram for the statistical analysis function is presented in Figure IV-4.

The DBMON User Interface takes the user specified statistical analysis files and conducts the Wilcoxon Rank-Sum Test (8:582). This nonparametric test determines if there is any statistical difference between the two specified statistical analysis files. The results of the analysis are presented to the user upon the terminal screen.

A nonparametric test was implemented because of its distribution-free nature. The use of a parametric test would have involved an assumption that the performance data is normally distributed. Since DBMON collected sample sizes may be small, it may be unreasonable to make an assumption of normality in the distribution of performance data. In the case of DBMON collected data, the distribution is not known in advance, and a nonparametric statistical test is preferred. The Wilcoxon Rank-Sum test is approximately 95% as efficient as the parametric t test when the actual distribution is normal (8:536). When the underlying distribution of performance data is not normal, the Wilcoxon Rank-Sum Test can be several times as efficient as the t test.
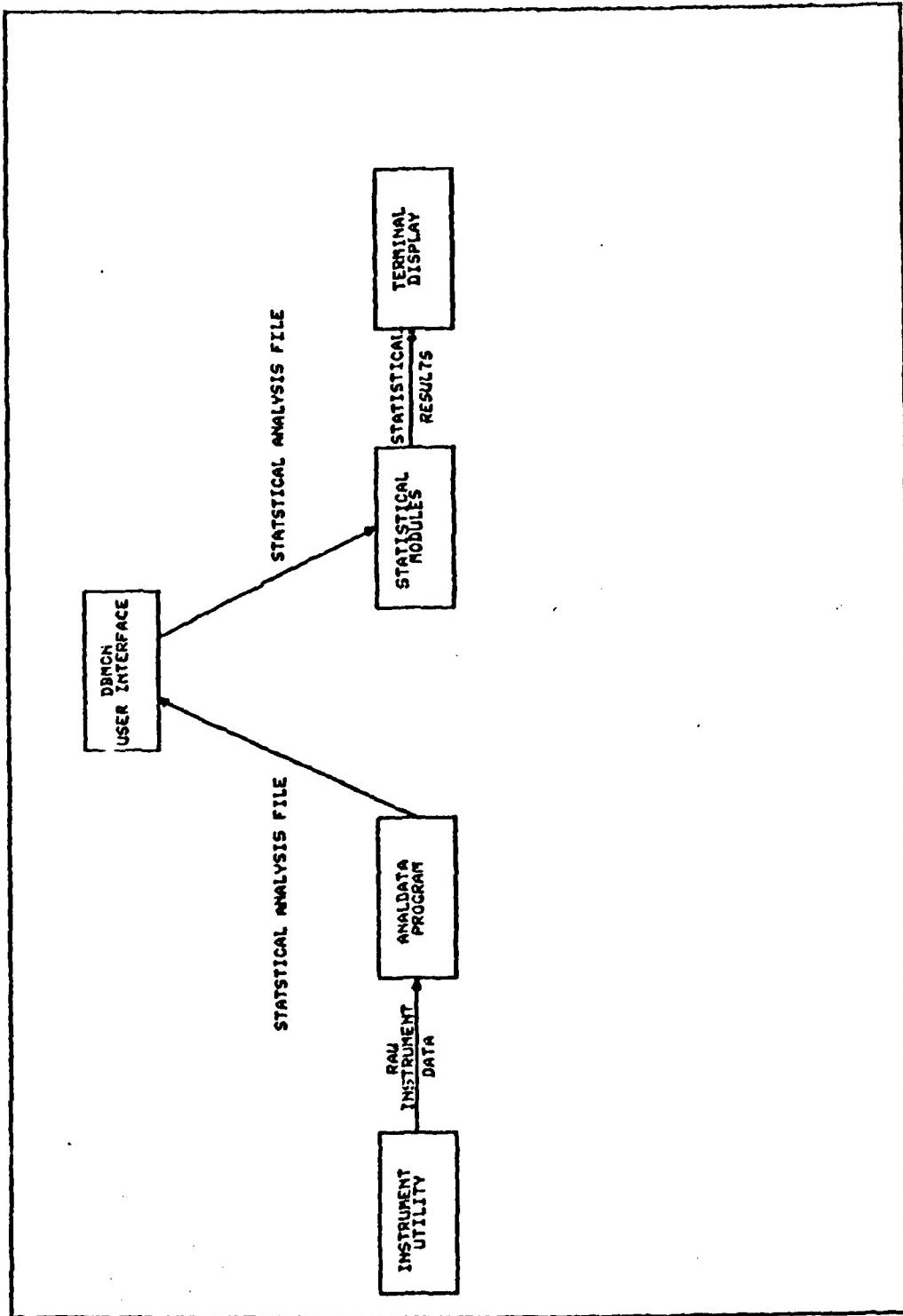
Figure IV-4 DBMON STATISTICS BLOCK DIAGRAM

An alternative to the Wilcoxon Rank-Sum Test is a
distribution-free Analysis of Variance (8:595). This ANOVA
is more complicated than the Rank-Sum Test but does allow
the use of one statistical procedure to analyze the affect
of several performance changes and thier effects in
different cases. The use of a nonparametric ANOVA could
simplify the statistical analysis of several DBMS
modifications implemented across more than one Data Base.
The Rank-Sum Test is capable of doing the same analysis in a
step by step fashion through the use of multiple pair-wise
comparisons. This is a conceptually simpler procedure that
can be just as effective as the nonparametric ANOVA.

All the parameters measured by the instrumentation
utility can be statistically compared between two
measurement session statistical files. The parameters are
the following.

(1) DML response times

(2) DML CPU usage times

(3) DML direct I/O count

(4) DML buffered I/O count

(5) DML page fault count

(6) DML working set size

Software Implementation Testing

The system test plan presented in appendix C was applied in order to validate the effectiveness of the software, and its ability to meet the requirements specifications in Appendix A. In all cases the software was developed so that the specifications were met and the Test Plan successfully completed. See Appendix F for the test results.

DBMON Operation

The details of DBMON operation are contained in Appendix E, the DBMON User's Guide. This section discusses some of the general operating features of DBMON. Figure IV-5 presents the general Data Flow Diagram for DBMON. An example of DBMON operation and the application of the DBMON User's Methodology is presented in Chapter V.

An application program that uses either the TOTAL or INGRES DBMS is required for use with DBMON. The application program can be written in any language that allows calls to VAX VMS Macro subroutines. This program will have calls to the Instrumentation Utility placed before and after each DBMS command. The utility calls will identify the calling program and the DML command which is to be monitored. When run the application program will execute the Instrumentation Utility and build a file of raw measurement data. During this measurement session computer system parameters will
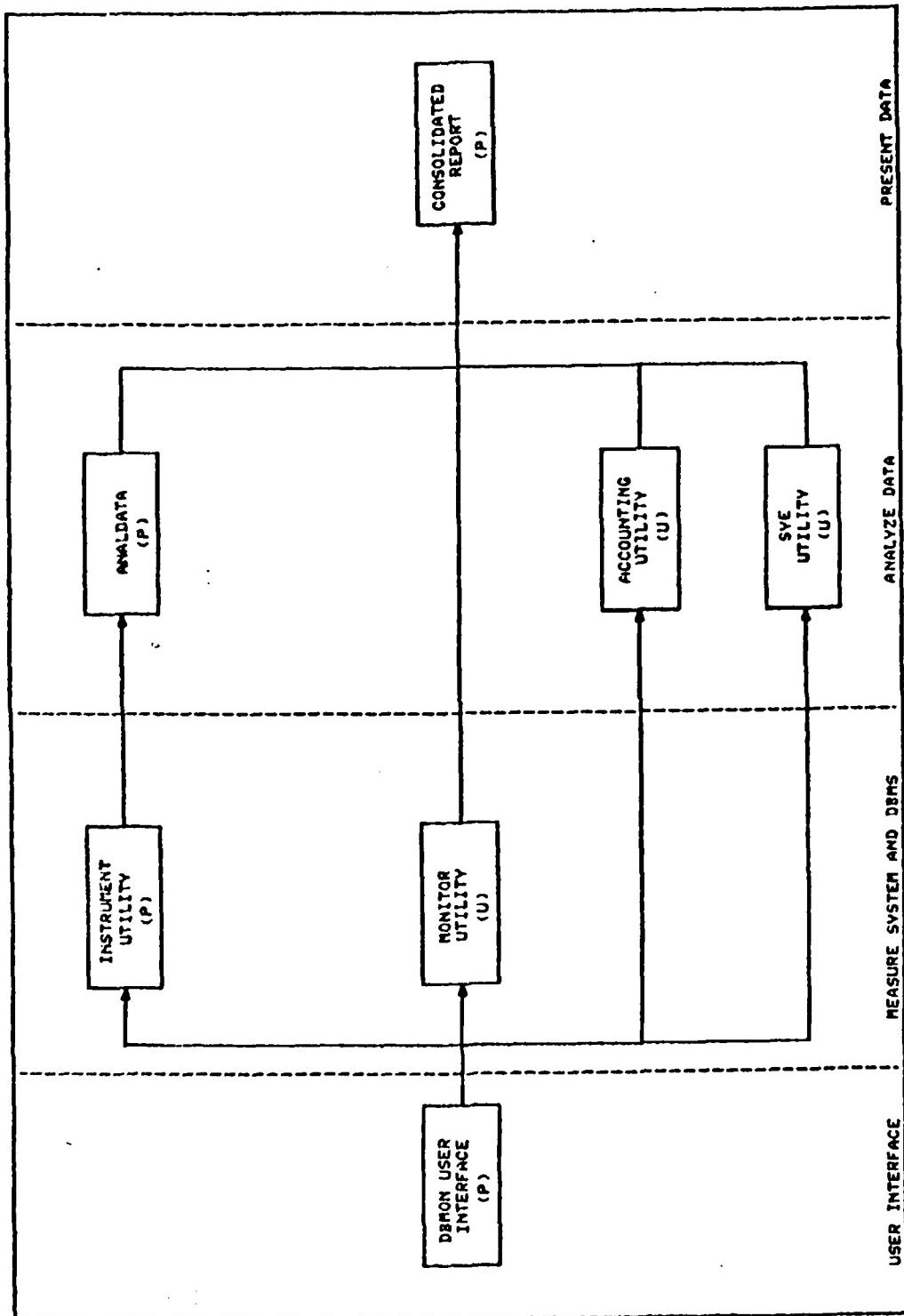
Figure IV-5 DBMON BLOCK DIAGRAM (P - DBMON PROGRAM, U - VAX/VMS UTILITY)

also be measured to produce the system parameter report.

The DBMON User Interface Program is used to set up a measurement session. The user specifies the type of performance measures that are required, and the duration of the measurement. This process initiates the measurement session. During the session system statistics are gathered and the DBMS application program is run. At the end of the session the Data Analysis Program is run to produce the instrumentation report.

The DBMON User Interface Program can now be used to view performance measurement reports directly, view reports graphically, and analyze the measurement data statistically. If the report is required for future use, it may be stored in the report library.

Once collected and analyzed, the DBMS analyst can use the DBMON provided information to help solve DBMS performance problems. Experiments may be conducted with instrumented DBMS application programs. The before and after test results can be statistically compared to determine the significance of the tested modifications. A more detailed analysis of the DBMS problem solving process is presented in the DBMON User's Guide in Appendix E.

Summary

    This chapter presented the implementation of software

modifications to the DBMON system. The chapter contained

the implementation plan, DBMS and programming language

selection, develpment computer configuration, general

software implementation description, and general DBMON

operation description. Appendix E contains the DBMON User's

Manual. Appendix F contains the Test Plan Results.

V. Results, Conclusions, and Recommendations

Introduction

This chapter contains the results of this study's continued development of the DBMON performance monitor, conclusions derived from this study, and recommendations for the further development of DBMON.

Implementation

DBMON development generally followed the previous design approaches (2;5). This study primarily concerned itself with a completion of the unimplemented portions of DBMON (see Chapter II). Specifically the following items were implemented during this thesis effort:

1. The DBMON system was interfaced with the INGRES DBMS.

2. A capability was provided for the graphical display of DBMS performance measurement information.

3. The ability to determine statistical differences between sets of performance data was implemented. This allows the determination of statistical difference between data sets.

4. A means of maintaining historical performance data in a report library was provided.

5. A DBMON User Methodology was developed for use with the DBMON system.

6. Online help information was included for the DBMON menus.

7. A comprehensive DBMON User's Guide was completed.

The DBMON system is documented through the use of SADT diagrams and an associated data dictionary. Further detail is provided by structure charts and their accompanying data dictionary. All code written for DBMON is fully commented and adheres to AFIT/ENG documentation standards (1).

Results

The result of this thesis effort is a comprehensive data base performance measurement tool. As a stand alone software tool it is capable of providing the DBMS analyst the information needed to diagnose performance problems, and test performance improvement modifications. The following discussion illustrates the use of the DBMON system through the use of the DBMON User's Methodology.

DBMON was applied to the Data Analysis Program which is a part of the DBMON software. The DBMON User's Methodology guided the performance improvement process with the following steps:

(1) Understanding System - Familiarization with the computer system, DBMSs, and the DBMON system was gained during the course of this thesis effort.

(2) Example Identification of Problem Areas - During testing

of the Data Analysis program, it became evident that the
response time was lengthy (more than 10 minutes). As a
matter of convenience an improvement in program response
time would be useful. The use of INGRES calls became the
prime suspect in the lengthy response times, since the
previous version of the data analysis program ran quickly
(less than 1 minute). In order to evaluate the response
time contribution to the program overall response time, the
program's INGRES calls were instrumented with the DBMON
instrumentation utility. The instrumented program was run
during a measurement session, and the resulting measurement
data was analyzed. A statistical analysis file was created
against which to guage any future performance improvements.
Graphical analysis of the measurement data as well as
examination of the Instrumentation report (Figure V-1)
revealed an average response time of 1.1 seconds.
Considering that 703 INGRES instructions were executed, 12.9
minutes of Data Analysis Program execution time could be
attributed to DBMS activity.

(3) Example Formulation of a Performance Improvement
Hypothesis - The collected measurement data was analyzed,
and it became evident that more than 90% of the program
response time was attributed to its embedded INGRES calls.
Figure V-1 shows the measurement report for the
pre-improvement data base. From examination of INGRES
reference manuals (14), a possible performance improvement

PROGRAM NAME: DATA ANALYSIS PROGRAM TEST 1

DML STATEMENT SUMMARY

RETRIEVAL COMMANDS
-------- --------

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(msec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
RETRV	total	1	4.860	1490	2	54	193	512
	average		4.860	1490.0	2.0	54.0	193.0	512.0
-sum-	total	1	4.860	1490	2	54	193	512
	average		4.860	1490.0	2.0	54.0	193.0	512.0

STORAGE COMMANDS
------- --------

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(msec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
APEND	total	687	377.420	76240	3434	1387	7	512
	average		0.549	111.0	5.0	2.0	0.0	512.0
DELET	total	6	190.220	29700	23	411	1556	512
	average		31.703	4950.0	3.8	68.5	259.3	512.0
REPLA	total	9	196.240	79570	87	2217	3836	512
	average		21.804	8841.1	9.7	246.3	426.2	512.0
-sum-	total	702	763.880	185510	3544	4015	5399	512
	average		1.088	264.3	5.0	5.7	7.7	512.0

SUMMARY OF ALL COMMANDS
------- -- --- --------

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(msec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
-sum-	total	703	768.740	187000	3548	4069	5592	512
	average		1.094	266.0	5.0	5.8	8.0	512.0

FIGURE V-1   INITIAL INTRUMENTATION REPORT

would be to use the INGRES provided optimization features in order to restructure the Data Base into a hash structure from its initial heap structure.

(4) Test Performance Improvements - During this step the data base was optimized using INGRES supplied procedures (14) OPTIMIZEDB and SYSMOD. The instrumented data analysis program was run again and a second set of measurement data collected. This data was analyzed and a statistical analysis file was created. Figure V-2 is the instrumentation report for this session. The performance improvements reduced INGRES response times approximately 50%. From examination of the reports it can be seen that the improvements came partially as a result of less CPU time used, but primarily because of the much smaller number of page faults encountered in the restructured data base. These observation were confirmed through the statistical comparison the the statistical analysis files created for both measurement sessions.

(5) Implement Performance Improvement Modifications - Due to the clear benefits of the hash data base structure it has been adopted for use by the DBMON data base and has been specified in the DBMON User's Guide. The User's Guide indicates the proper procedures required to install the hashed INGRES data base structure.

PROGRAM NAME: DATA ANALYSIS PROGRAM TEST 2

DML STATEMENT SUMMARY

RETRIEVAL COMMANDS

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(msec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
RETRV	total	1	2.230	1290	2	62	113	512
	average		2.230	1290.0	2.0	62.0	113.0	512.0
-sum-	total	1	2.230	1290	2	62	113	512
	average		2.230	1290.0	2.0	62.0	113.0	512.0

STORAGE COMMANDS
-------- --------

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(nsec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
APEND	total	687	206.180	74460	3432	1387	2	512
	average		0.300	108.4	5.0	2.0	0.0	512.0
DELET	total	6	51.210	28510	21	459	564	512
	average		8.535	4751.7	3.5	76.5	94.0	502.7
REPLA	total	9	125.900	79800	85	2513	2929	512
	average		13.989	8866.7	9.4	279.2	325.4	512.0
-sum-	total	702	383.290	182770	3538	4359	3495	512
	average		0.546	260.4	5.0	6.2	5.0	511.9

SUMMARY OF ALL COMMANDS
------- -- --- --------

COMMAND NAME	TYPE INFORMATION	EXECUTION COUNT	RESPONSE TIME(secs)	CPU TIME(msec)	BUFFERED I/O	DIRECT I/O	PAGE FAULTS	WORKING SET
-sum-	total	703	385.520	184060	3540	4421	3608	512
	average		0.548	261.8	5.0	6.3	5.1	511.9

FIGURE V-2   POST MODIFICATION INTRUMENTATION REPORT

The above sample application of the DBMON User's Methodology
is representative of the procedures that can be used in
applying DBMON as a performance improvemnt tool.

Conclusions

The following conclusions were formed from the study of
the DBMON system.

1. DBMON is now a comprehesive tool for the analysis of
INGRES and TOTAL DBMS operation.
2. The DBMON User's Methodology is a valid system for the
analysis of DBMS performance problems.
3. The documentation techniques of SADTs, Structure
Charts, and Data Dictionaries are effective methods for
the documentation of newly developed software and
modifications to existing software.

Recommendations

The first recommendation, that can be suggested, is
that DBMON now be put into use as an analysis tool. From
the practical experience of that use, improvements and
extensions are sure to be suggested. The problem reporting
form in Appendix G can be used to report software problems
and improvement suggestions to the AFIT/ENG ISL.

Four areas for potential DBMON enhancements include
extensions to the following:

(1) Statistical analysis can be extended to allow for a nonparametric analysis of variance (ANOVA). This would allow for a more simple statistical evaluation process in the case of multiple factor analysis.

(2) Graphical analysis of performance data can be extended to provide for a greater variety of graphical representations, such as scattergrams and pie charts. This would help customize DBMON to the personal preferences of the monitor users. An interface to the ISO Graphic Kernal System (GKS) may be appropriate.

(3) DBMON's ability to function with DBMSs can be extended to DEC's DATATRIEVE (9). This would further enhance DBMON's applicability and scope of usability.

(4) Improvments to the User Interface can be made by the incorporation of a color monitor. Color can be used to highlight the menus and graphics produced by DBMON to emphasize important information. GKS may be appropriate for this application.

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This study was concerned with the completion of a Data Base Management System (DBMS) performance evaluation tool named DBMON. The previously existing version of DBMON was also developed at the AFIT Information Sciences Laboratory.

The generalized design for a DBMS performance monitor was changed to include the statistical and graphical analysis of performance data, the maintenance of a performance report library, and monitor operation with the INGRES DBMS. These design features were then implemented into a new version of the DBMON system.

A DBMON User's Methodology was developed and applied to the diagnosis and correction of DBMS performance problems using the DBMON system.
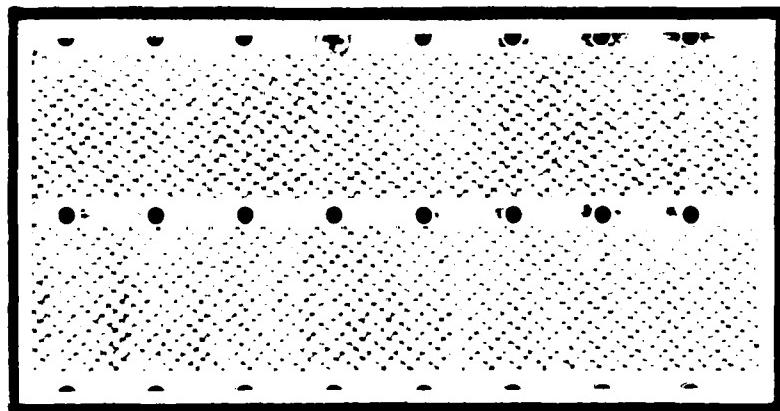
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DEVELOPMENT COMPLETION OF A DATA BASE
MANAGEMENT SYSTEM PERFORMANCE MONITOR
VOLUME II

THESIS

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AFIT/GCS/ENG/85D-17

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THESIS

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Alexander B. Wasilow, A.B.
Captain, USAF

December 1985

Table of Contents

VOLUME II

Appendix A

Functional Requirements

Table of Contents

Introduction

This appendix contains the complete set of functional requirements for a DBMS performance monitor derived from Appendix A of reference (5). These requirements include the additions to DBMON made during this study. Changes and additions are in items 3.2, 4.4, 4.5, and 5.0.

FUNCTIONAL REQUIREMENTS OF A DBMS PERFORMANCE MONITOR

1.0   Establish a user interface to the monitor.

   1.1   Allow the user to select a set of performance
parameters to be measured.

   1.2   Allow the user to specify and initiate the
measurement collection process.

   1.3   Allow the user to check the status of the
measurement performance process.

   1.4   Allow the user to terminate the measurement
collection process gracefully.

   1.5   Allow the user to specify the types of analysis to
be performed on the measurement data.

   1.6   Allow the user to specify the method of data
presentation.

2.0   Measure the selected set of performance data.

   2.1   Record measurement data in data files.

   2.2   Map the selected performance parameters to the
measurement sources.

   2.3   Minimize monitor artifact by recording only the
requested set of performance parameters.

   2.4   Start the measurement session at the specified
time.

   2.5   Stop the measurement session at the specified

time.

3.0 Analyze the measured values for the performance
parameters.

   3.1 Perform the required mathematical operations to
provide the requested performance data.

      3.1.1 Create a file of analyzed performance
measurement data.

   3.2 Perform the necessary statistical/graphical
analysis.

      3.2.1 Allow the user to specify statistical tests
to be performed on the measurement data.

      3.2.2 Allow the user to specify graphical
representations to be made of the measurement data.

      3.2.3 Create output files of statistical and
graphical analysis data.

4.0 Present the measurement data to the user.

   4.1 Create the performance report.

   4.2 Print the performance report upon the system
printer in as many copies as needed.

   4.3 Display the performance report upon a video
terminal.

   4.4 Display graphical presentations of the specified
performance measurement data.

   4.5 Allow the user to maintain historical performance

A-4

measurement data in a library.

   4.5.1   Allow the user to store performance reports
in a library.

   4.5.2   Allow the user to retrieve performance
reports from a library.

   4.5.3   Allow the user to delete performance
reports from a library.

5.0 Have all operating instructions and procedures in a
comprehensive DBMON user's manual.

Appendix B

DBMON Design Documentation

Table of Contents

Introduction

This appendix contains the current complete design documentation for a DBMS performance monitor. The documentation consists of an index of SADT activity diagrams, the activity diagrams, and a data dictionary. The data dictionary specifies the composition and characteristics of the data elements in the SAD1 diagrams.

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            A21 Map Performance Parameters to Measurement Source
            A22 Create Performance Tool Commands or Instructions
            A23 Create or Initialize Measurement Data Files
            A24 Activate Performance Tools
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      A3   Analyze Measurement Data Files

            A31 Analyze Measurement Data Files
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                 A423 Delete Report
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            A44 Display Page to User
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PERFORMANCE
MEASUREMENT
REPORT

DBMS PERFORMANCE MONITOR

PERFORMANCE
MEASUREMENT
TOOLS

SYSTEM
INSTRUMENTATION

USER INPUT
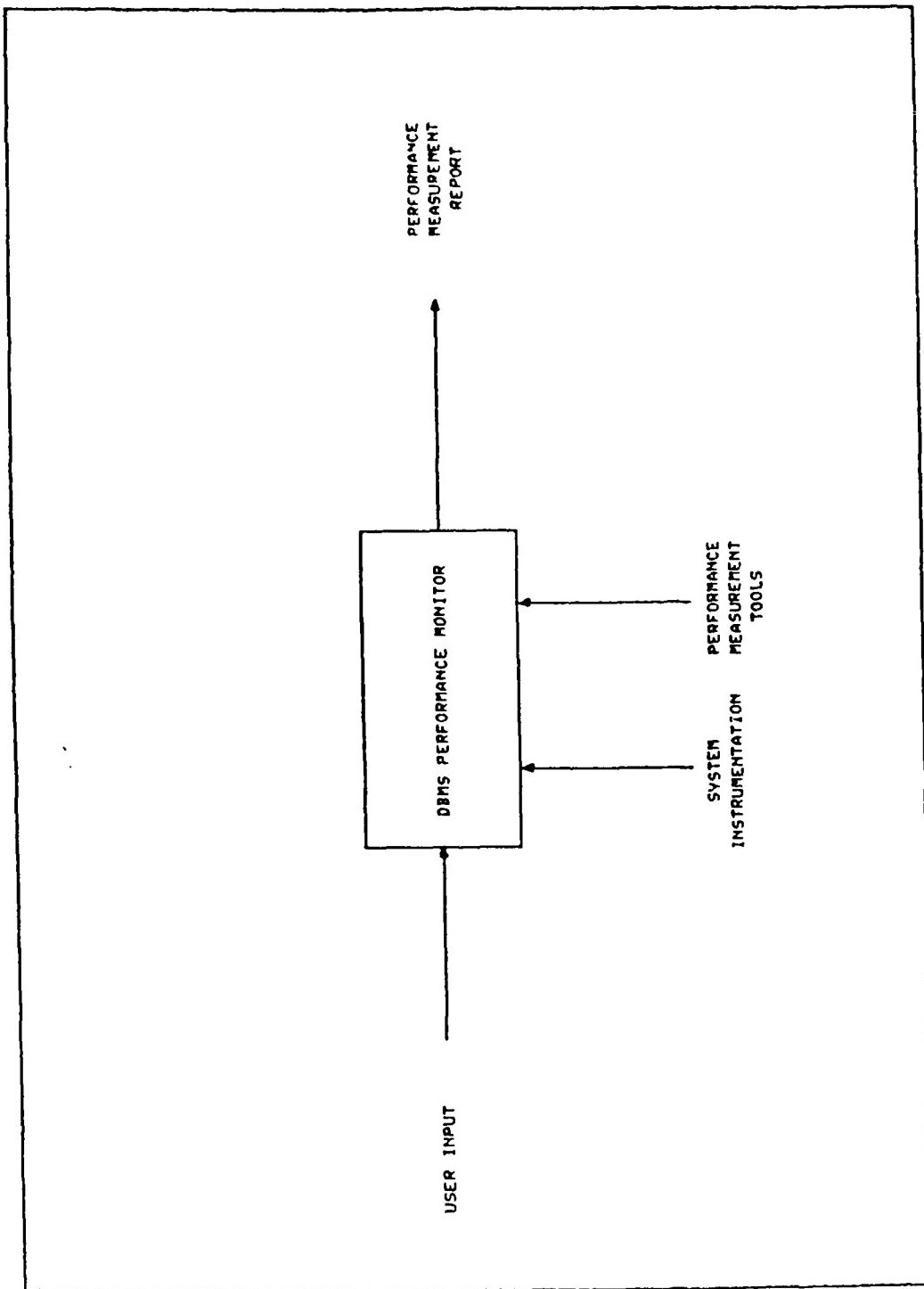
Figure B-1 NODE A-0 DBMS PERFORMANCE MONITOR CONTEXT DIAGRAM
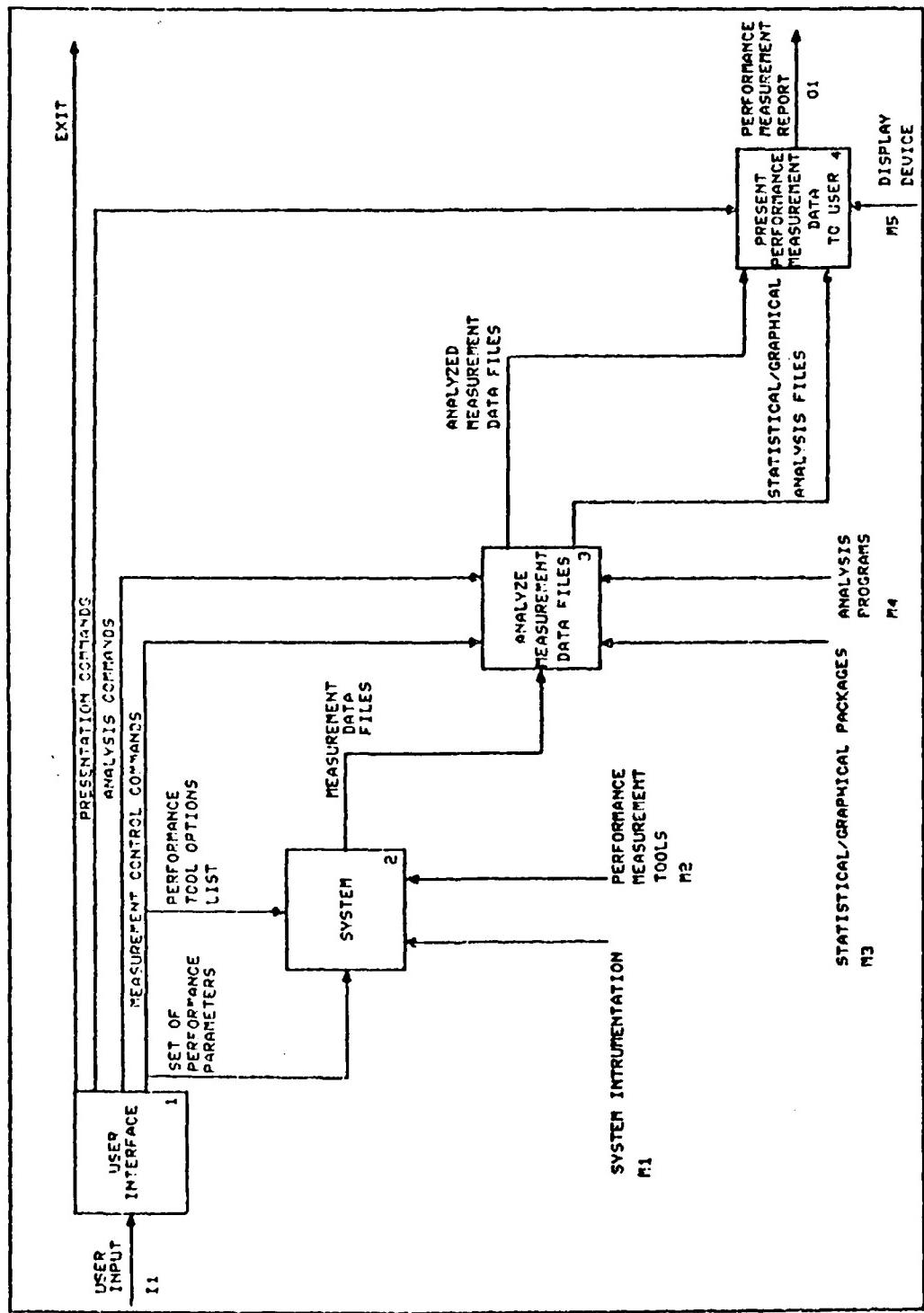
Figure B-2 NODE A0 DBMS PERFORMANCE MONITOR
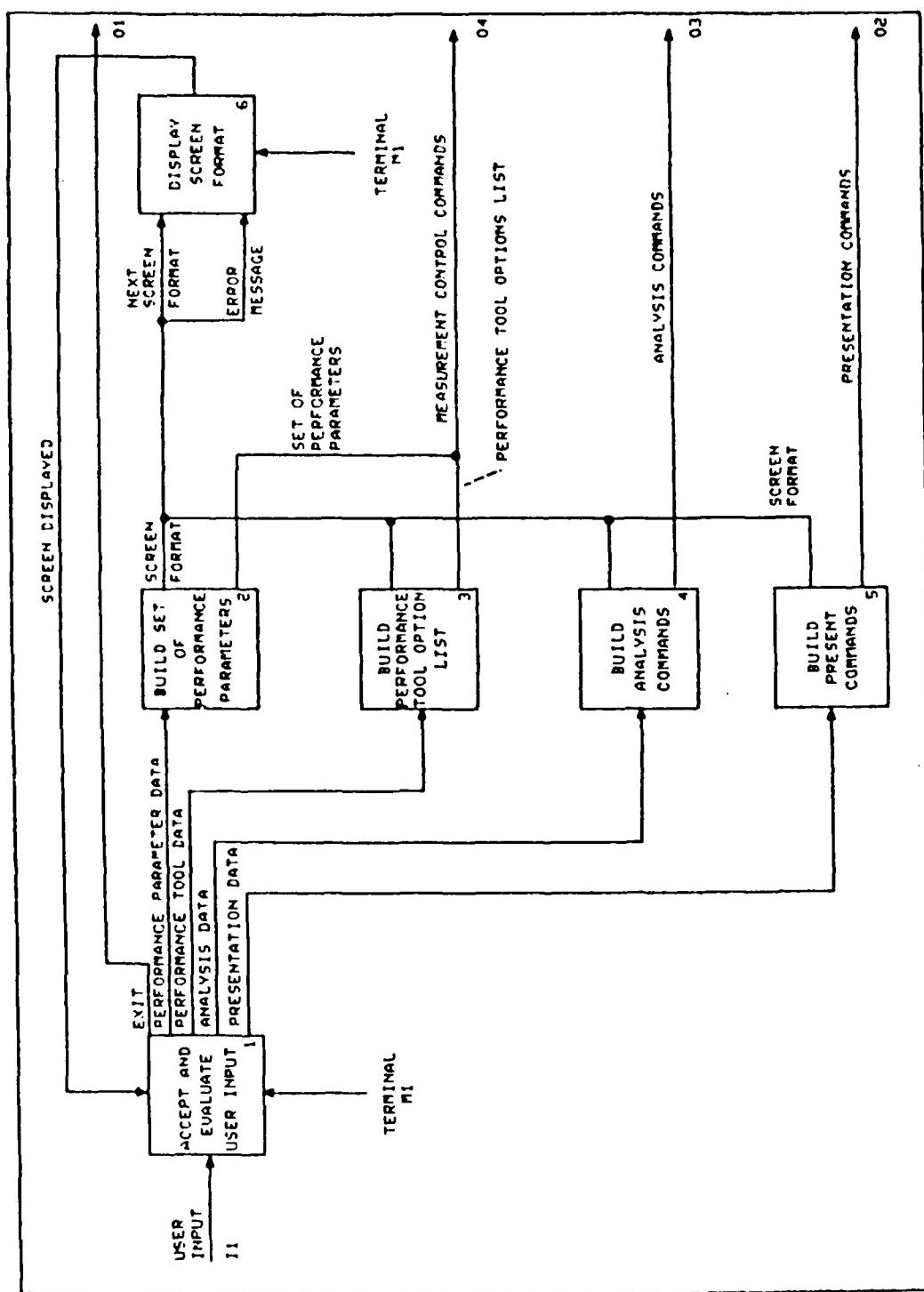
Figure B-3 NODE A1 USER INTERFACE
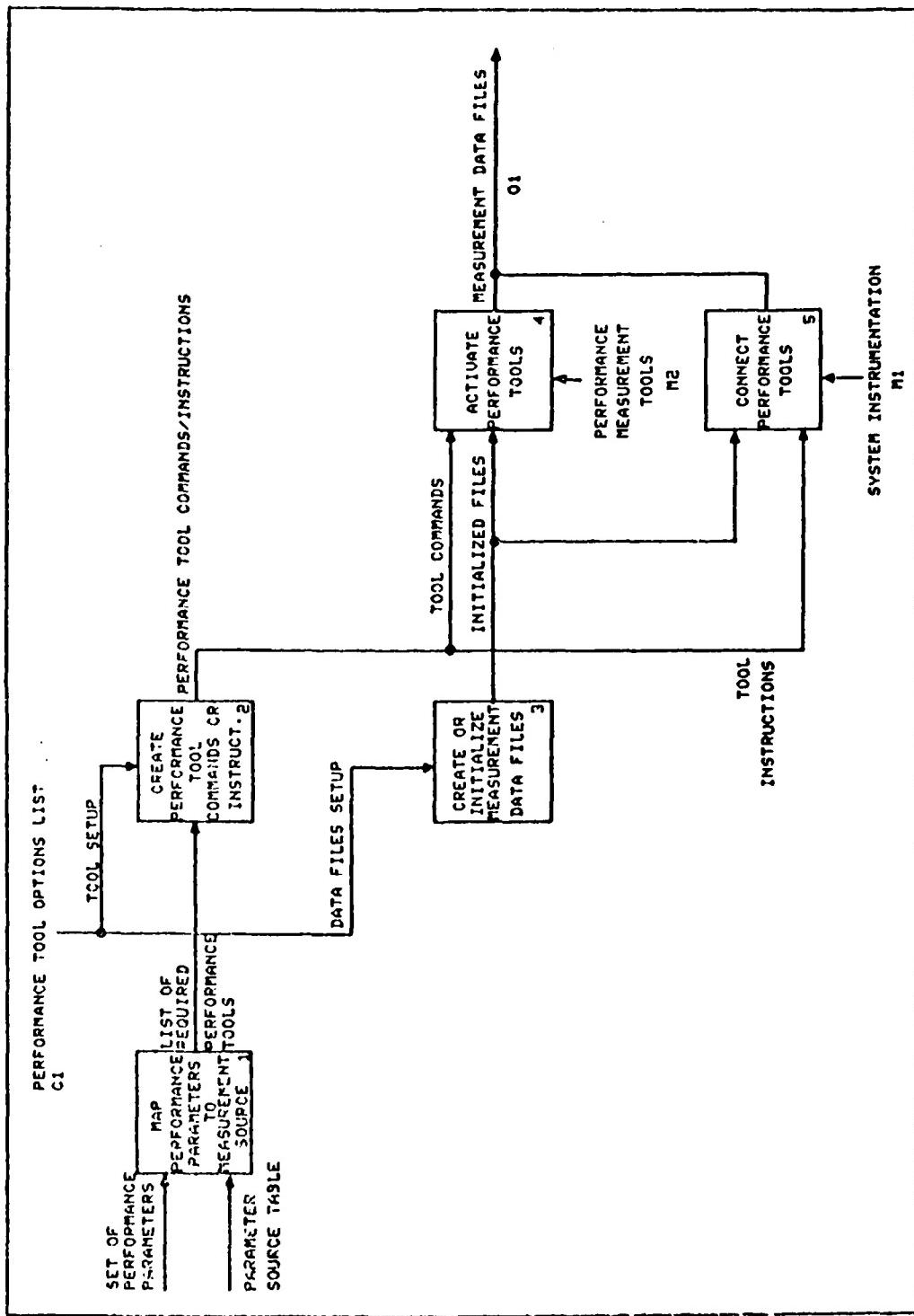
Figure B-4 NODE A2 MEASURE SYSTEM AND DBMS

B-7
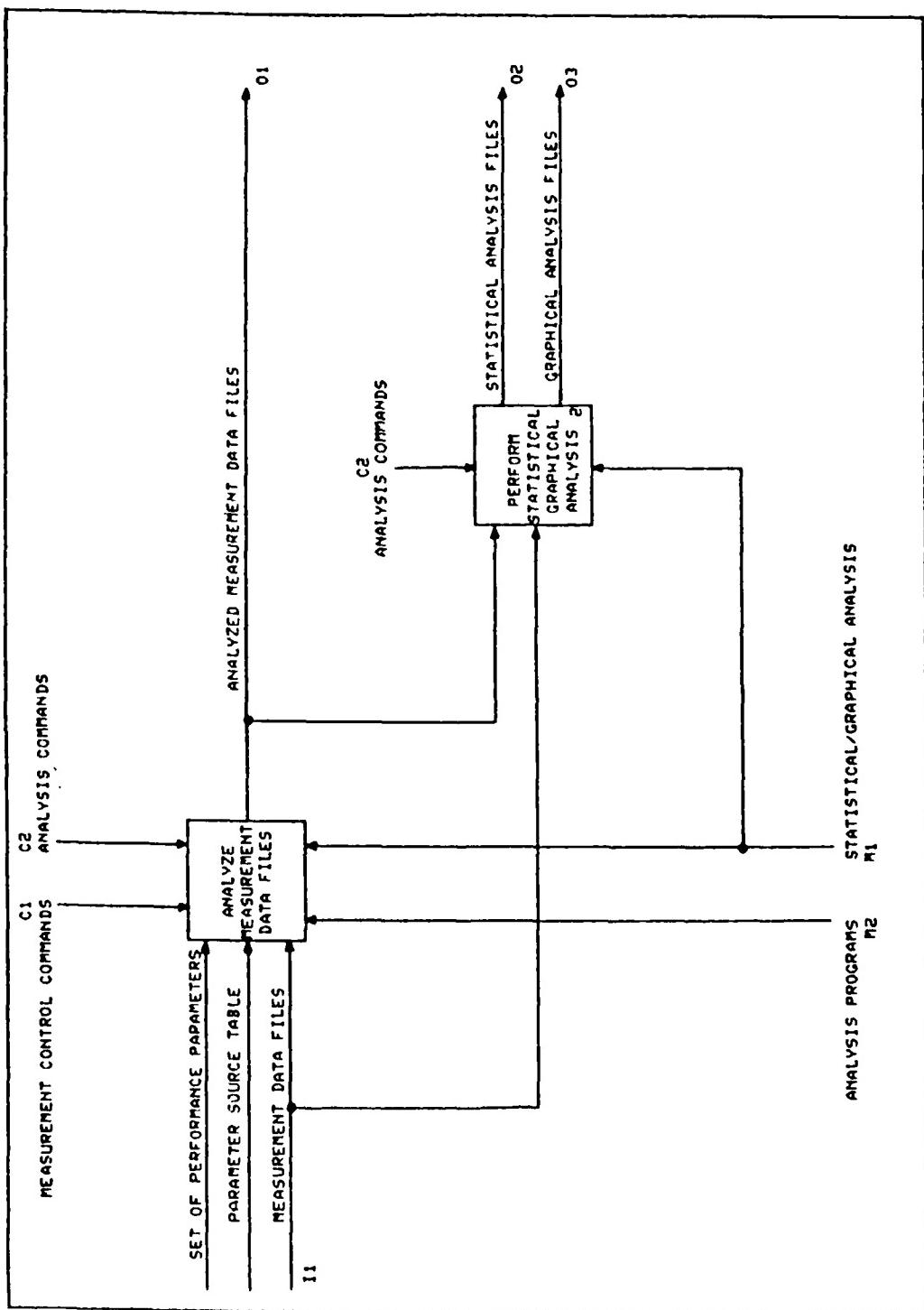
Figure B-5 NODE A3 ANALYZE MEASUREMENT DATA FILES

B-8
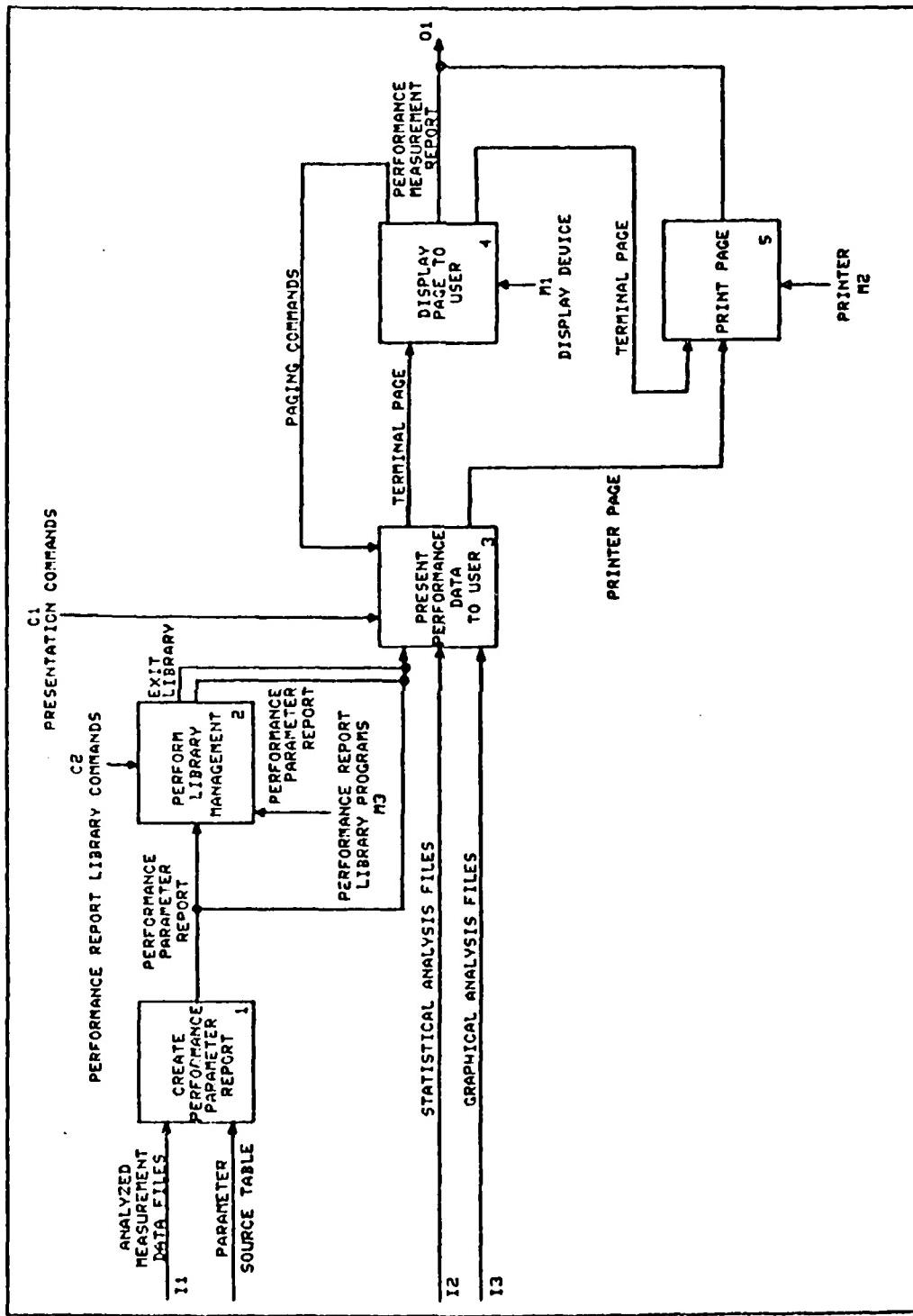
Figure B-6   NODE A4   PRESENT PERFORMANCE MEASUREMENT TO USER
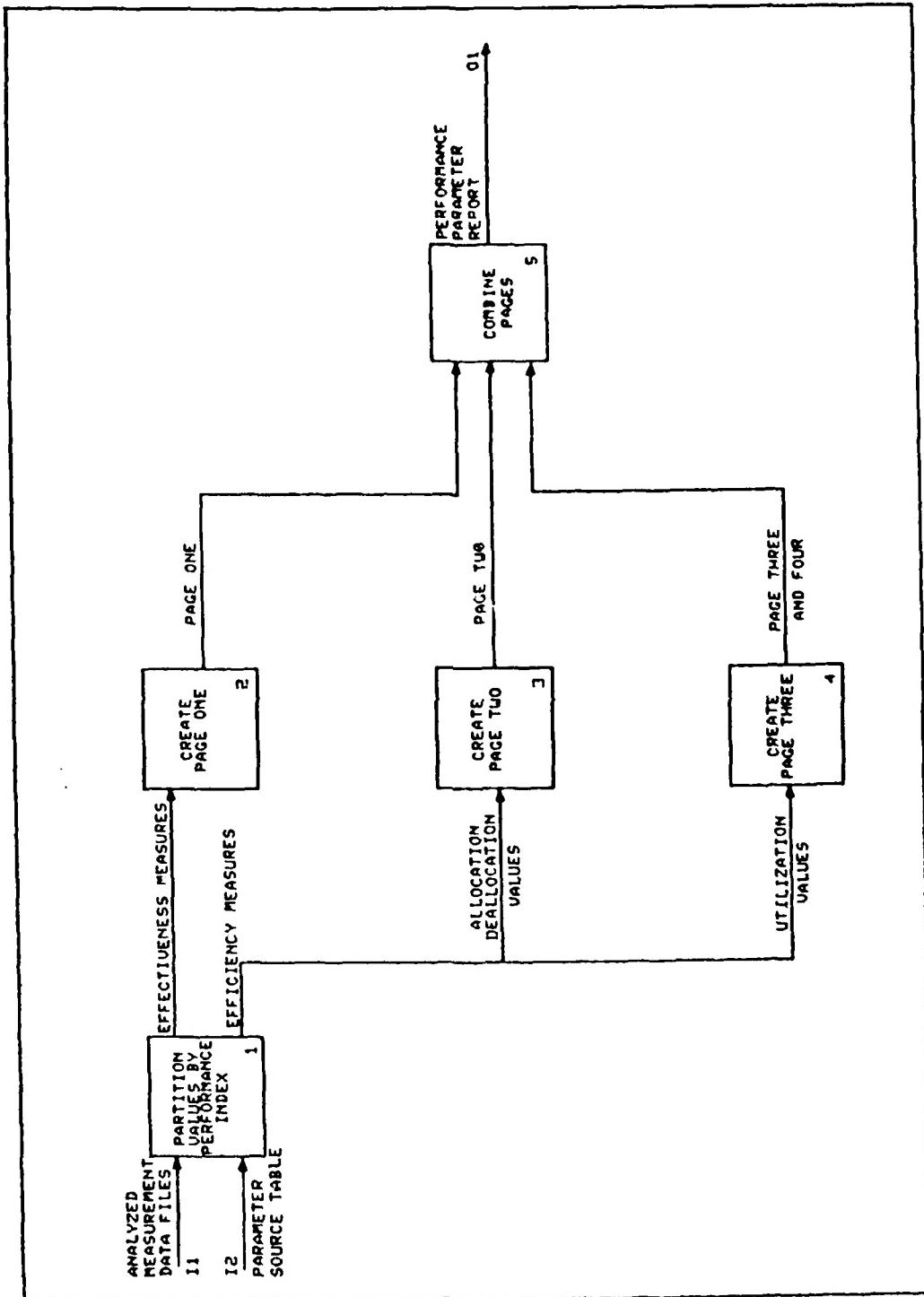
Figure B-7 NODE A41 CREATE PERFORMANCE PARAMETER REPORT

B-10
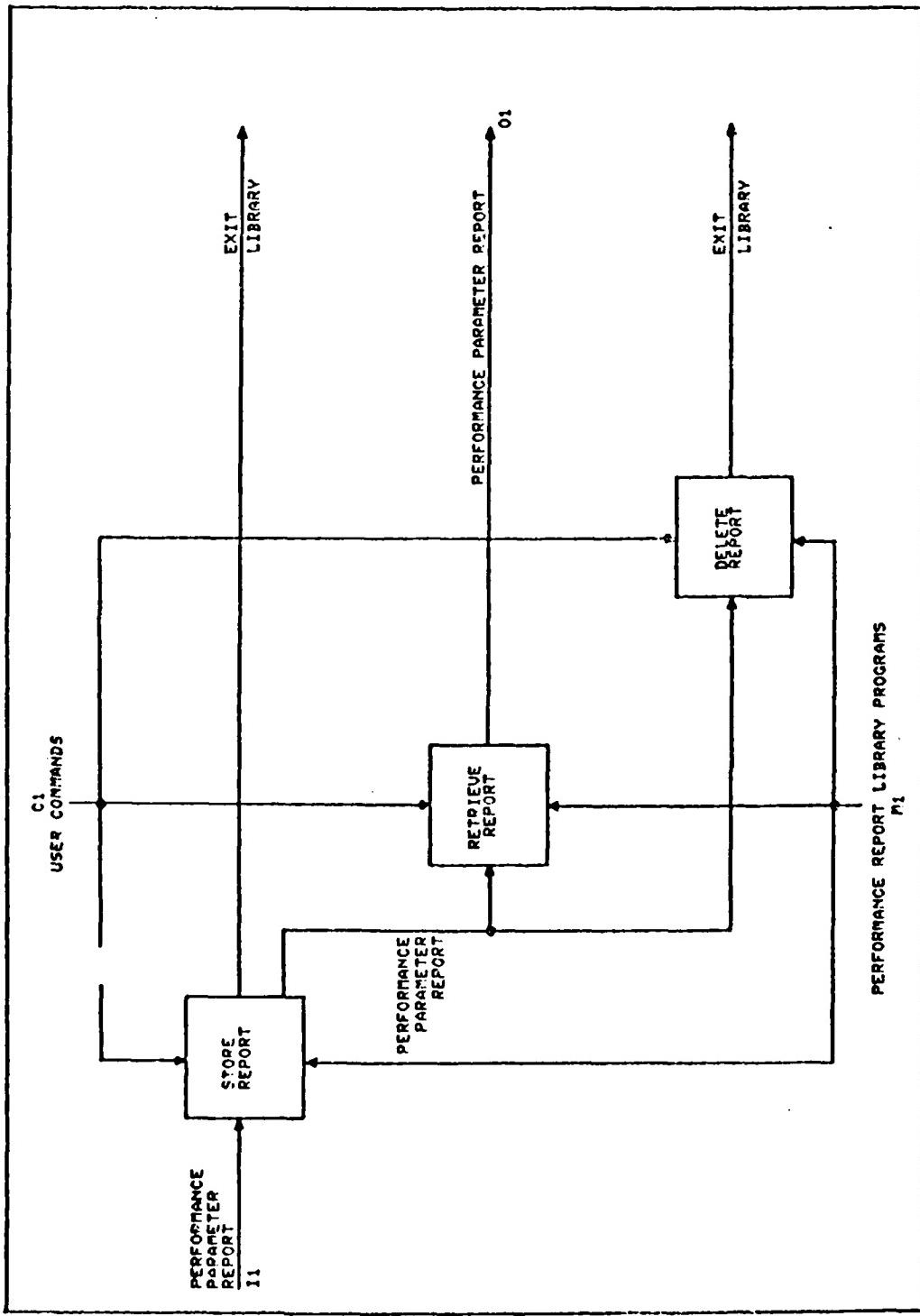
Figure B-8 NODE A42 PERFORM LIBRARY MANAGEMENT

B-11

A-0   DBMS Performance Monitor Context Diagram

Abstract: This diagram is the context diagram which provides
a top level view of the system design of a DBMS Performance
Monitor.

AO   DBMS Performance Monitor

Abstract: This diagram shows the four major activities that
must be accomplished by the DBMS Performance Monitor.

        A1   User Interface - This Activity accepts the user's
input to the DBMS Performance Monitor.   It allows the user
to specify the set of performance parameters to be measured,
the start and stop time of the measurement session, the
types of data analysis to be performed, and how the
measurement data is to be presented.   The data specified by
the user is formatted into command sets which are used as
the interface mechanism to other major activities of the
performance monitor.

        A2   Measure System and DBMS - This activity initiates
the performance measurement tools which record values for
the selected set of performance parameters.

        A3   Analyze Measurement Data Files - This activity
takes the measurement data files produced by the performance
tools and performs statistical and graphical manipulations
on the data.   It calculates parameters that are not directly
measureable, conducts statistical analysis, and produces
graphical representations of the data.

        A4   Present Performance Measurement Data to User - This
activity presents the performance measurement report to the
user and maintains a historical library of performance
reports.

A1   User Interface

Abstract: This Activity accepts the user's input to the DBMS
Performance Monitor. It allows the user to specify the set
of performance parameters to be measured, the start and stop
time of the measurement session, the types of data analysis
to be performed, and how the measurement data is to be
presented. The data specified by the user is formatted into
command sets which are used as the interface mechanism to
other major activities of the performance monitor.

A11   Accept and Evaluate User Input - This activity
accepts the data entered by the user and evaluates it to
determine which processing activity the data must be passed
to for building a command set. It also determines when the
user wants to exit the user interface.

A12   Build Set of Performance Parameters - This
activity builds the set of performance parameters the user
wants to measure.

A13   Build Performance Tool Option List - This activity
constructs the list of performance tool options.

A14   Build Analysis Commands - This activity builds the
commands used to control the execution of the analysis
programs and the statistical package.

A15   Build Presentation Commands - This activity builds
the commands used to control the execution of data
presentation programs.

A16   Display Screen Format - This activity displays
screen formats and error messages onto the user's terminal.
This is the key activity that interacts with the user.

A2   Measure System and DBMS

Abstract: This activity initiates the performance tools
which measure and record values for the selected set of
performance parameters.

A21   Map Performance Parameters to Measurement Source -
This activity selects the performance tools required to
measure values for the set of performance parameters selected
by the monitor user.

A22   Create Performance Tool Commands or Instructions -
This activity creates the system commands used to initiate
the performance tools. In the event a command cannot be
created because the performance tool cannot be automatically
initiated, a set of instructions for connecting the
performance tool to the system and initiating its operation
are created.

A23   Create or Initialize Measurement Data Files - This
activity creates new files or initializes old files used to
record the measured values of the performance parameters.

A24   Activate Performance Tools - This activity causes
the performance tools to activate and begin measuring the
system and the DBMS.

A25   Connect Performance Tools - This activity describes
the connection process of a performance tool, such as a
hardware monitor, that requires operator intervention before
it can be used to measure DBMS performance.

A3   Analyze Measurement Data Files

Abstract: This activity takes the measurement data files
produced by the performance tools and performs statistical
and graphical manipulations on the data. It calculates
parameters that are not directly measureable, conducts
statistical analysis, and produces graphical representations
of the data.

     A31   Analyze Measurement Data Files - This activity
uses math-statistical packages and specialized analysis
programs to perform mathematical analysis on the measurement
data.   These calculations are used to derive values for
performance parameters that are not otherwise directly
measureable.

     A32   Perform Statistical/Graphical Analysis - This
activity uses statistical and graphical packages to perform
analysis of the measurement data. It produces analysis
results such as histograms, scattergrams, regression
analysis, hypothesis testing, etc.

A4   Present Performance Measurement Data to User

Abstract: This activity presents the performance
measurement report to the user and maintains a historical
library of performance reports.
      A41   Create Performance Parameter Report - This
activity creates a report of the measured values for the
performance parameters organized by their corresponding
performance index and parameter names.

      A42   Perform Library Management - This activity
maintains a library of historical performance reports.

      A43   Present Performance Data to User - This activity
controls the presentation of the performance data to the
user of the monitor.

      A44   Display Page to User - This Activity displays a
page of the performance measurement report on the screen of
the user terminal.   It allows the user to selectively view
the desired parts of the performance measurement report.

      A45   Print Page - This activity prints a page of the
performance report on the system printer.
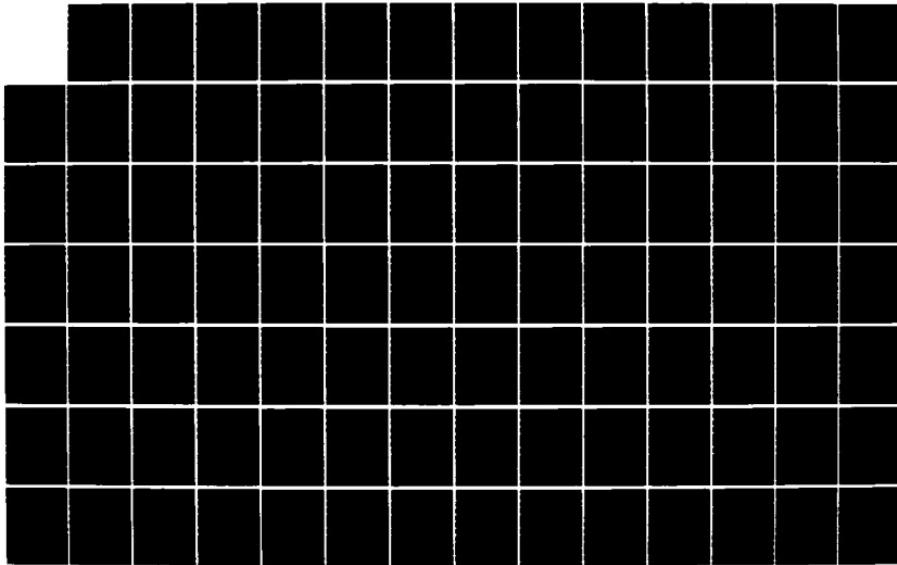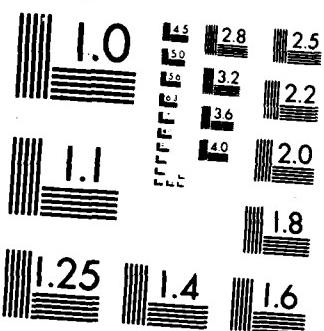
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

A41   Create Performance Parameter Report
Abstract: This activity creates a report of the measured
values for the performance parameters organized by their
corresponding performance index and parameter names.

A411   Partition values by Performance Index - This
activity reads the analyzed measurement data files and
organizes the values according to their corresponding
performance index and performance parameter name.

A412   Create Page One - This activity creates the first
page of the performance parameter report which contains all
the effectiveness measures.

A413   Create Page Two - This activity creates the
second page of the performance parameter report which
contains the allocation values of the efficiency measures.

A414   Create Page Three and Four - This activity
creates the third and fourth pages of the performance
parameter report. These pages contain all the utilization
values of the efficiency measures.

A415   Combine Pages - This activity compiles all the
parts of the performance parameter report.

A42   Perform Library Management

Abstract: This activity maintains a library of historical performance reports.

    A421   Store Report - This activity stores performance reports into a library for future use.

    A422   Retrieve Report - This activity retrieves stored reports for viewing by the monitor user.

    A423   Delete Report - This activity deletes reports from the library at the user's request.

SADT SYSTEM DESIGN DOCUMENTATION

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A-0
NAME: DBMS Performance Monitor Context Diagram
INPUTS: User Input
OUTPUTS: Performance Measurement Report
CONTROL: None
MECHANISMS: System Instrumentation, Performance Measurement
Tools
DESCRIPTION: Top level view of the DBMS Performance Monitor.
RELATED REQUIREMENT NUMBER: All
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A0
NAME: DBMS Performance Monitor
INPUTS: User Input
OUTPUTS: Performance Measurement Report
CONTROL: None
MECHANISMS: System Instrumentation, Performance Measurement
Tools
DESCRIPTION: This diagram shows the four main activities
that are accomplished by the DBMS Performance Monitor.
RELATED REQUIREMENT NUMBER: All
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A1
NAME: User Interface
INPUTS: User Input
OUTPUTS: Exit, Measurement Control Commands, Analysis
Commands, Presentation Commands
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity accepts the user's input to the
DBMS Performance Monitor. It allows the user to specify the
set of performance parameters to be measured, the start and
stop times of the measurement session, the types of data
analysis to be performed, and how the measurement data is to
be presented. The data specified by the user is formatted
into command sets which are used as the interface mechanism
to the other major activities of the performance monitor.
RELATED REQUIREMENT NUMBER: 1.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A11
NAME: Accept and Evaluate User Input
INPUTS: User Input
OUTPUTS: Exit, Performance Parameter Data, Analysis Data,
Presentation Data
CONTROL: Screen Displayed
MECHANISMS: Terminal
DESCRIPTION: This activity accepts the data entered by the
user and evaluates it to determine which processing activity
the data must be passed to for building a command set. It
also determines when the user wants to exit the user
interface.
RELATED REQUIREMENT NUMBER: 1.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A12
NAME: Build Set of Performance Parameters
INPUTS: Performance Parameter Data
OUTPUTS: Screen Format Command, Set of Performance
Parameters
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity builds the set of performance
parameters the user wants to measure.
RELATED REQUIREMENT NUMBER: 1.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A13
NAME: Build Performance Tool Option List
INPUTS: Performance Tool Data
OUTPUTS: Screen Format Command, Performance Tool Option List
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity builds the option list for the
performance tools
RELATED REQUIREMENT NUMBER: 1.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A14
NAME: Build Analysis Commands
INPUTS: Analysis Data
OUTPUTS: Screen Format Command, Analysis Commands
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity builds the commands used to
control the execution of the analysis programs and the
statistical/graphical package.
RELATED REQUIREMENT NUMBER: 1.5
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A15
NAME: Build Presentation Commands
INPUTS: Presentation Data
OUTPUTS: Screen Format Command, Presentation Commands
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity builds the commands used to
control the execution of data presentation programs.
RELATED REQUIREMENT NUMBER: 1.6
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A16
NAME: Display Screen Format
INPUTS: Next Screen Format, Error Message
OUTPUTS: Screen Displayed
CONTROL: None
MECHANISMS: Terminal
DESCRIPTION: This activity displays screen formats and error
messages onto the user's terminal. This is the key activity
that interfaces with the user.
RELATED REQUIREMENT NUMBER: 1.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A2
NAME: Measure System and DBMS
INPUTS: Set of Performance Parameters
OUTPUTS: Measurment Data Files
CONTROL: Performance Tool Option List
MECHANISMS: System Instrumentation, Performance Measurement
Tools
DESCRIPTION: This activity initiates the performance tools
which measure and record values for the selected set of
performance parameters.
RELATED REQUIREMENT NUMBER: 2.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A21
NAME: Map Performance Parameters to Measurement Source
INPUTS: Set of Performance Parameters, Parameter Source
Table
OUTPUTS: List of Required Performance Tools
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity selects the performance tools
required to measure values for the set of performance
parameters selected by the user of the monitor.
RELATED REQUIREMENT NUMBER: 2.2
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A22
NAME: Create Performance Tool Commands or Instructions
INPUTS: List of Required Performance Tools
OUTPUTS: Performance Tool Commands or Instructions
CONTROL: Tool Setup
MECHANISMS: None
DESCRIPTION: This activity creates the system commands used
to initiate the performance tools. In the event a command
cannot be created because the performace tool cannot be
automatically initiated, a set of instructions for
connecting the performance tool to the system and initiating
its operation are created.
RELATED REQUIREMENT NUMBER: 2.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A23
NAME: Create or Initialize Measurement Data Files
INPUTS: None
OUTPUTS: Initialized Files
CONTROL: Data Files Setup
MECHANISMS: None
DESCRIPTION: This activity creates new files or initalizes
old files used to record the measured values of the
performance parameters.
RELATED REQUIREMENT NUMBER: 2.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A24
NAME: Activate Performance Tools
INPUTS: Tool Commands, Initialized Files
OUTPUTS: Measurement Data Files
CONTROL: None
MECHANISMS: System Instrumentation
DESCRIPTION: This activity causes the performance tools to
activate and begin measuring the system and the DBMS.
RELATED REQUIREMENT NUMBER: 2.4
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A25
NAME: Connect Performance Tools
INPUTS: Tool Instructions, Initialized Files
OUTPUTS: Measurement Data Files
CONTROL: None
MECHANISMS: System Instrumentation
DESCRIPTION: This activity is the connection process of a
performance tool that requires operator intervention before
it can begin to function.
RELATED REQUIREMENT NUMBER: 2.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A3
NAME: Analyze Measurement Data Files
INPUTS: Measurement Data Files
OUTPUTS: Analyzed Measurement Data Files, Statistical
Analysis Files, Graphical Analysis Files
CONTROL: Analysis Commands
MECHANISMS: Statistical/Graphical Package, Analysis Programs
DESCRIPTION: This activity takes the measurement data files
produced by the performance tools and performs mathematical
analysis on the data. It calculates values for performance
parameters that are not directly measureable as well as
performing statistical/graphical analysis on the data files.
RELATED REQUIREMENT NUMBER: 3.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A31
NAME: Analyze Measurement Data Files
INPUTS: Set of Performance Parameters, Measurement Data
Files, Parameter Source Table
OUTPUTS: Analyzed Measurement Data Files
CONTROL: Analysis Commands
MECHANISMS: Statistical Package, Analysis Programs
DESCRIPTION: This activity uses the statistical package and
specialized programs to perform mathematical calculations on
the measurement data. These calculations are used to derive
performance parameters that are not directly measureable.
RELATED REQUIREMENT NUMBER: 3.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A32
NAME: Perform Statistical/Graphical Analysis
INPUTS: Measurement Data Files, Analyzed Measurement Data
Files
OUTPUTS: Statistical and Graphical Analysis Files
CONTROL: Analysis Commands
MECHANISMS: Statistical/Graphical Package
DESCRIPTION: This activity uses the statistical package to
perform statistical analysis of the measurement data. The
Graphical package is used to format measurement data into a
graphical presentation.
RELATED REQUIREMENT NUMBER: 3.2
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A4
NAME: Present Performance Data to User
INPUTS: Analyzed Measurement Data Files, Statistical and
Graphical Analysis Files
OUTPUTS: Performance Measurement Report
CONTROL: Presentation Commands
MECHANISMS: Display Device
DESCRIPTION: This activity presents the performance
measurement data to the user in the form of a performance
measurement report.
RELATED REQUIREMENT NUMBER: 4.0
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A41
NAME: Create Performance Parameter Report
INPUTS: Analyzed Measurement Data Files, Parameter Source
Table
OUTPUTS: Performance Measurement Report
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity creates a report of the measured
values for the performance parameters organized by their
corresponding performance index and parameter names.
RELATED REQUIREMLNT NUMBER: 4.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A411
NAME: Partition Values by Performance Index
INPUTS: Analyzed Measurement Data Files, Parameter Source
Table
OUTPUTS: Effectiveness Measures, Efficiency Measures
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity reads the analyzed measurement
data files and organizes the values according to their
corresponding performance index and parameter names.
RELATED REQUIREMENT NUMBER: 4.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A412
NAME: Create Page One
INPUTS: Effectiveness Measures
OUTPUTS: Page One
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity creates the first page of the
performance report which contains all of the effectiveness
measures.
RELATED REQUIREMENT NUMBER: 4.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A413
NAME: Create Page Two
INPUTS: Allocation/Deallocation Values
OUTPUTS: Page Two
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity creates the second page of the
performance parameter report which contains the allocation
and deallocation values of the efficiency measures.
RELATED REQUIREMENT NUMBER: 4.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A414
NAME: Create Page Three and Four
INPUTS: Utilization Values
OUTPUTS: Page Three and Four
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity creates the third and fourth
pages of the performance parameter report which contains the
utilization values of the efficiency measures.
RELATED REQUIREMENT NUMBER: 4.1
ALIASES: None

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TYPE: Activity
DATE: 05 JUL 85
NUMBER: A415
NAME: Combine Pages
INPUTS: Page One, Page Two, Page Three, and Page Four
OUTPUTS: Performance Parameter Report
CONTROL: None
MECHANISMS: None
DESCRIPTION: This activity combines the pages of the report
into one consolidated report.
RELATED REQUIREMENT NUMBER: 4.1
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A42
NAME: Perform Library Management
INPUTS: Performance Parameter Report
OUTPUTS: Performance Parameter Report
CONTROL: User Commands
MECHANISMS: DBMS
DESCRIPTION: This activity maintains a library of historical
performance reports.
RELATED REQUIREMENT NUMBER: 4.4
ALIASES: None

```
TYPE: Activity
DATE: 05 JUL 85
NUMBER: A421
NAME: Store Report
INPUTS: Performance Parameter Report
OUTPUTS: Exit, Performance Parameter Report
CONTROL: User Commands
MECHANISMS: DBMS
DESCRIPTION: This activity stores performance parameter
reports into the report library.
RELATED REQUIREMENT NUMBER: 4.4
ALIASES: None
```

```
TYPE: Activity
DATE: 05 JUL 85
NUMBER: A422
NAME: Retrieve Report
INPUTS: Performance Parameter Report
OUTPUTS: Performance Parameter Report
CONTROL: User Commands
MECHANISMS: DBMS
DESCRIPTION: This activity retrieves performance parameter
reports that have been stored in the library.
RELATED REQUIREMENT NUMBER: 4.4
ALIASES: None
```

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A423
NAME: Delete Report
INPUTS: Performance Parameter Report
OUTPUTS: Exit
CONTROL: User Commands
MECHANISMS: DBMS
DESCRIPTION: This activity deletes performance parameter
reports from the report library.
RELATED REQUIREMENT NUMBER: 4.4
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A43
NAME: Present Performance Data to User
INPUTS: Performance Parameter Report, Statistical Analysis
Files, Graphical Analysis Files
OUTPUTS: Terminal Page, Printer Page
CONTROL: Presentation Commands, Paging Commands
MECHANISMS: None
DESCRIPTION: This activity controls the presentation of the
performance data to the user of the monitor.
RELATED REQUIREMENT NUMBER: 4.2
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A44
NAME: Display Page to User
INPUTS: Terminal Page, User Input
OUTPUTS: Paging Commands, Terminal Page, Performance
Measurement Report
CONTROL: None
MECHANISMS: Display Device
DESCRIPTION: This activity displays a page of the
performance measurement report or the graphical
representation on the screen of a terminal. It allows the
user to selectively view and/or print the desired parts of
the performance measurement report.
RELATED REQUIREMENT NUMBER: 4.2, 4.4
ALIASES: None

TYPE: Activity
DATE: 05 JUL 85
NUMBER: A45
NAME: Print Page
INPUTS: Terminal Page, Printer Page
OUTPUTS: Performance Measurement Report
CONTROL: None
MECHANISMS: System Printer
DESCRIPTION: This activity prints a page of the performance
measurement report on the system printer.
RELATED REQUIREMENT NUMBER: 4.2
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Allocation/Deallocation Values
DESCRIPTION: Measured values for the allocation and
deallocation performance parameters which are part of the
system efficiency measures.
SOURCES: A411
DESTINATIONS: A413
COMPOSITION: None
PART OF: Efficiency Measures
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Analysis Commands
DESCRIPTION: The set of commands used to control the
analysis of measurement data recorded by the performance
tools.
SOURCES: A1, A14
DESTINATIONS: A3, A31, A32
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Analysis Data
DESCRIPTION: Data input by the user to specify how the
measurement data is to be analyzed. It is used to build a
set of Analysis Commands.
SOURCES: A11
DESTINATIONS: A14
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric, String
VALUES: 0 to Max Size, System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Analysis Programs
DESCRIPTION: Specially designed computer programs for
analyzing the measurement data produced by the performance
tools.
SOURCES: System Program Library
DESTINATIONS: A3, A31
COMPOSITION: None
PART OF: N/A
DATA TYPE: Executable Computer Code
VALUES: System Alphabet
ALIASES: None

```
TYPE: Data Element
DATE: 05 JUL 85
NAME: Analyzed Measurement Data Files
DESCRIPTION: Data files containing the measurement data
after it has been analyzed by the analysis programs and the
statistical/graphical package.
SOURCES: A3, A31
DESTINATIONS: A32, A4, A41, A411
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None


TYPE: Data Element
DATE: 05 JUL 85
NAME: Data Files Setup
DESCRIPTION: Part of the performance tool options list used
to control the creation and initialization of the
measurement data files.
SOURCES: A13
DESTINATIONS: A23
COMPOSITION: None
PART OF: Performance Tool Options List
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None
```

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TYPE: Data Element
DATE: 05 JUL 85
NAME: Display Device
DESCRIPTION: Device used to display the performance
measurements to the user.
SOURCES: System Hardware
DESTINATIONS: A4, A44
COMPOSITION: None
PART OF: N/A
DATA TYPE: Hardware
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Effectiveness Measures
DESCRIPTION: A major category of performance indexes used to
classify performance parameters.
SOURCES: A411
DESTINATIONS: A412
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Efficiency Measures
DESCRIPTION: A major category of performance indexes used to
classify performance parameters.
SOURCES: A411
DESTINATIONS: A413, A414
COMPOSITION: Alocation/Deallocation Values, Utilization
Values
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Error Message
DESCRIPTION: Informational message to be displayed to a user
of the monitor to inform of incorrect or invalid input.
SOURCES: A12, A13, A14, A15
DESTINATIONS: A16
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Exit
DESCRIPTION: Denotes a user's exit from the user interface
of the monitor.
SOURCES: A1, A11
DESTINATIONS: Operating System
COMPOSITION: None
PART OF: N/A
DATA TYPE: N/A
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Exit Library
DESCRIPTION: Denotes a user's exit from the performance data
library.
SOURCES: A42, A421, A423
DESTINATIONS: A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: N/A
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Graphical Analysis Files
DESCRIPTION: Files containing the graphical presentation of
performance measurement data.
SOURCES: A32
DESTINATIONS: A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Initialized Files
DESCRIPTION: Data files that have been created or
initialized before the beginning of a measurement session.
SOURCES: A23
DESTINATIONS: A24, A25
COMPOSITION: None
PART OF: N/A
DATA TYPE: File
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: List of Required Performance Tools
DESCRIPTION: List of the performance tools that must be used
to measure values for the set of performance parameters
selected by the user.
SOURCES: A21
DESTINATIONS: A22
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Initialized Files
DESCRIPTION: Data files that have been created or
initialized before the beginning of a measurement session.
SOURCES: A23
DESTINATIONS: A24, A25
COMPOSITION: None
PART OF: N/A
DATA TYPE: File
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Measurement Control Commands
DESCRIPTION: Set of commands used to specify and control a
performance measurement session.
SOURCES: A1, A12, A13
DESTINATIONS: A2, A21, A3, A31
COMPOSITION: Set of Performance Parameters, Performance Tool
Options List
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Measurement Data Files
DESCRIPTION: Data files used to record the measurements
taken by the performance tools.
SOURCES: A2, A24, A25
DESTINATIONS: A3, A31, A32
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Next Screen Format
DESCRIPTION: Specifies the next screen format to be
displayed to the monitor user.
SOURCES: A12, A13, A14, A15
DESTINATIONS: A16
COMPOSITION: None
PART OF: Screen Format
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Page One
DESCRIPTION: Page one of the performance parameter report.
It contains the effectiveness measures.
SOURCES: A412
DESTINATIONS: A415
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Page Two
DESCRIPTION: Page two of the performance parameter report.
It contains the allocation/deallocation values of the
efficiency measures.
SOURCES: A413
DESTINATIONS: A415
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Page Three and Four
DESCRIPTION: Page three and four of the performance
parameter report. It contains the utilization values of the
efficiency measures.
SOURCES: A414
DESTINATIONS: A415
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Paging Commands
DESCRIPTION: Commands used to control the displaying of the
performance parameter report on the terminal.
SOURCES: A44
DESTINATIONS: A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Parameter Source Table
DESCRIPTION: Data structure used to map a performance
parameter to a source it can be measured from.
SOURCES: DBMS Monitor Software
DESTINATIONS: A21, A31, A41, A411
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric, String
VALUES: 0 to Max Size, System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Measurement Report
DESCRIPTION: Performance measurement report presented to
monitor users. It contains values for the performance
parameters and statistical analysis.
SOURCES: A4, A44, A45
DESTINATIONS: Monitor User
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Measurement Tools
DESCRIPTION: Software/hardware tools used to measure and
record values for the selected set of performance
parameters.
SOURCES: System Software
DESTINATIONS: A2, A24
COMPOSITION: None
PART OF: N/A
DATA TYPE: Executable Code or Hardware Device
VALUES: N/A
ALIASES: None

```
TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Parameter Data
DESCRIPTION: Data input by the user to specify the set of
performance parameters to be measured.
SOURCES: A11
DESTINATIONS: A12
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric, String
VALUES: 0 to Max Size, System Alphabet
ALIASES: None
```

```
TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Parameter Report
DESCRIPTION: Report containing values for the set of
performance parameters selected by the user.
SOURCES: A41, A415, A42, A421, A422
DESTINATIONS: A42, A421, A422, A423, A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None
```

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Report Library Commands
DESCRIPTION: User input that directs the performance report
library.
SOURCES: User Input
DESTINATIONS: A42, A421, A422, A423
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Report Library Programs
DESCRIPTION: Software that enables operation of the
performance report library.
SOURCES: DBMS Monitor Software
DESTINATIONS: A42, A421, A422, A423, A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: Executable Code
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Tool Commands and Instructions
DESCRIPTION: System commands and instructions for initiating
a performance tool to begin measuring and recording values.
SOURCES: A22
DESTINATIONS: A23, A24
COMPOSITION: Tool Commands, Tool Instructions
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Tool Data
DESCRIPTION: Data input by the user to specify operational
parameters for the performance tools (i.e. start time, stop
time). It is used to build the performance tool options
list.
SOURCES: All
DESTINATIONS: A13
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Performance Tool options List
DESCRIPTION: Set of options used to create a complete
command for a performance tool. Typically this list
contains items such as: start time, stop time, and file
options.
SOURCES: A1, A13
DESTINATIONS: A2, A22, A23
COMPOSITION: Tool Setup, Data Files Setup
PART OF: Measurement Control Commands
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Presentation Commands
DESCRIPTION: Set of commands used to control the
presentation of the measurement data to the user of the
monitor.
SOURCES: A1, A15
DESTINATIONS: A4, A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Presentation Data
DESCRIPTION: Data input by the user to specify how the
measurement data is to be presented. It is used to build a
set of presentation commands.
SOURCES: A11
DESTINATIONS: A14
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Printer
DESCRIPTION: System printer used to produce a paper copy of
the performance measurement report.
SOURCES: System Hardware
DESTINATIONS: A45
COMPOSITION: None
PART OF: N/A
DATA TYPE: Hardware
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Printer Page
DESCRIPTION: Formatted page of the performance measurement
report to be printed on the system printer.
SOURCES: A43
DESTINATIONS: A45
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Screen Displayed
DESCRIPTION: Used to control the display of screen formats
and the entry of data by the user. It ensures that the
screen format has been displayed before the user attempts to
enter any data.
SOURCES: A16
DESTINATIONS: All
COMPOSITION: None
PART OF: N/A
DATA TYPE: Boolean
VALUES: True or False
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Screen Format
DESCRIPTION: Specifies what is to be displayed on the
terminal when a user is entering data through the user
interface.
SOURCES: A12, A13, A14, A15
DESTINATIONS: A16
COMPOSITION: None
PART OF: N/A
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Set of Performance Parameters
DESCRIPTION: Specifies the set of performance parameters the
user of the monitor wants to measure and record.
SOURCES: A1, A12
DESTINATIONS: A2, A21, A31
COMPOSITION: None
PART OF: Measurement Control Commands
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Statistical Analysis Files
DESCRIPTION: Files produced as a result of performing
statistical analysis on the measurement data.
SOURCES: A3, A32
DESTINATIONS: A4, A43
COMPOSITION: None
PART OF: N/A
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Statistical/Graphical Package
DESCRIPTION: Software that provides statistical analysis and
presents performance data in a graphical representation.
SOURCES: System Program Library
DESTINATIONS: A3, A31, A32
COMPOSITION: None
PART OF: N/A
DATA TYPE: Executable Computer Code
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: System Instrumentation
DESCRIPTION: The system facilities used to connect
performance tools to the measured system.
SOURCES: System Software, Operating System
DESTINATIONS: A2, A25
COMPOSITION: None
PART OF: N/A
DATA TYPE: Executable Code
VALUES: N/A
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Terminal
DESCRIPTION: Hardware device used to interface with the
monitor software.
SOURCES: System Hardware
DESTINATIONS: A11, A16
COMPOSITION: None
PART OF: N/A
DATA TYPE: Hardware Device
VALUES: N/A
ALIASES: Display Device

TYPE: Data Element
DATE: 05 JUL 85
NAME: Terminal Page
DESCRIPTION: Screen content being displayed upon the user's
terminal.
SOURCES: A43, A44
DESTINATIONS: A45
COMPOSITION: None
PART OF: N/A
DATA TYPE: Report
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Tool Commands
DESCRIPTION: Commands used to initiate a performance tool to
begin measuring and recording values.
SOURCES: A22
DESTINATIONS: A24
COMPOSITION: None
PART OF: Performance Tool Commands/Instructions
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Tool Instructions
DESCRIPTION: Instructions for connecting and initiating a
performance tool that requires human intervention.
SOURCES: A22
DESTINATIONS: A25
COMPOSITION: None
PART OF: Performance Tool Commands/Instructions
TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Tool Setup
DESCRIPTION: Specifies how the performance tool is to be
setup and used.
SOURCES: A1, A13
DESTINATIONS: A22
COMPOSITION: None
PART OF: Performance Tool Options List
DATA TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: User Input
DESCRIPTION: Data and commands entered at the terminal by
the monitor user.
SOURCES: Monitor User
DESTINATIONS: A1, A11
COMPOSITION: None
PART OF: N/A
TYPE: String
VALUES: System Alphabet
ALIASES: None

TYPE: Data Element
DATE: 05 JUL 85
NAME: Utilization Values
DESCRIPTION: Part of efficency measures that are placed on
page three and four of the performance parameter report.
SOURCES: A41
DESTINATIONS: A44
COMPOSITION: None
PART OF: Efficiency Measures
DATA TYPE: Numeric
VALUES: 0 to Max Size
ALIASES: None

Appendix C

Additions to Test Plan

Table of Contents

Introduction

This appendix contains the additions the the test plan contained in Appendix D (2). The additions to the test plan correspond to the changes in the functional requirements in Appendix A. Test plan additions in this appendix correspond to functional requirements 3.2, 4.4, 4.5 and 5.0

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2 - Perform the necessary statistical and/or graphical analysis.

TEST CASES:

1. No analysis requested.
2. One specific analysis requested.
3. All possible analysis requested.

EXPECTED RESPONSE:

1. No analysis performed.
2. Requested analysis performed.
3. All possible analysis performed.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____
CASE 3. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2.1 - Allow the user to specify statistical tests to be performed on the measurement data.

TEST CASES:

1. No test is requested.
2. One specific test is requested.
3. All possible tests are requested.

EXPECTED RESPONSE:

1. No analysis is scheduled.
2. Requested analysis is scheduled.
3. All possible analysis is scheduled.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____
CASE 3. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2.2 - Allow the user to specify graphical
representations to be made of the measurement data.

TEST CASES:

1. No graphical representation is requested.
2. One graphical representation is requested.
3. All possible graphics are requested.

EXPECTED RESPONSE:

1. No graphics are scheduled.
2. Requested graphics is scheduled.
3. All possible graphics are scheduled.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____
CASE 3. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2.3 - Create output files of statistical and graphical analysis data.

TEST CASES:

1. No statistical/graphical analysis is requested.
2. Some statistical/graphical analysis is requested.

EXPECTED RESPONSE:

1. No output files are created.
2. A statistical/graphical output file is created.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.4 - Display graphical presentations of the
specified performance measurement data.

TEST CASES:

1. No graphical representation was requested.
2. One graphical representation was requested.
3. All possible graphics were requested.

EXPECTED RESPONSE:

1. No graphics are displayed.
2. One graphical representation is availble for display.
3. All possible graphics are availible for display.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____
CASE 3. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

REQUIREMENT: 4.5 - Allow the user to maintain historical
performance measurement data.

TEST CASES:

1. No library maintenance requested.
2. Library maintenance activity is requested.

EXPECTED RESPONSE:

1. No library activity is undertaken.
2. Requested library function is performed.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.1 - Allow the user to store performance
reports in a library.

TEST CASES:

   1. No storage of reports is requested.
   2. Library storage is requested.

EXPECTED RESPONSE:

   1. No report storage occurs.
   2. A performance report is stored in the library.

RESULTS:

   CASE 1. - PASS:_____ FAIL:_____ DATE:_____
   CASE 2. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.2 - Allow the user to retrieve performance
reports from a library.

TEST CASES:

1. No retrieval of reports is requested.
2. Library retrieval is requested.

EXPECTED RESPONSE:

1. No report retrieval occurs.
2. A performance report is retrieved from the library.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

TEST PLAN ADDITIONS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.3 - Allow the user to delete performance
reports from a library.

TEST CASES:

1. No deletion of reports is requested.
2. Library deletion is requested.

EXPECTED RESPONSE:

1. No report deletion occurs.
2. A performance report is deleted from the library.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____
CASE 2. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

REQUIREMENT: 5.0 - Have all operating instructions and procedures in a comprehensive user's manual.

TEST CASES:

1. Manual represents all the operating instructions for the performance monitor.

EXPECTED RESPONSE:

1. The manual is complete in its coverage of monitor operations.

RESULTS:

CASE 1. - PASS:_____ FAIL:_____ DATE:_____

REMARKS:

Appendix D

System Design Documentation - Structure Charts

Table of Contents

Introduction

This appendix contains the program documentation for the design changes made during the course of this study. The program documentation consists of structure charts and data dictionaries. Structure chart entries marked with * refer the reader to reference 2. Structure chart entries marked with ** refer to reference 5.

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

Chart Index

0.0   USER INTERFACE

   1.0   INITIALIZE DATE TABLE

   2.0   DISPLAY WELCOME SCREEN

   3.0   DISPLAY MENU

     3.1 MAIN MENU

        3.1.1   ESTABLISH MEASUREMENT SESSION
        3.1.2   SHOW SESSION STATUS
        3.1.3   DELETE MEASUREMENT SESSION
        3.1.4   DISPLAY MEASUREMENT DATA

            3.1.4.1   DISPLAY SESSION INFORMATION
            3.1.4.2   DISPLAY MEASUREMENT REPORT
            3.1.4.3   DISPLAY STATISTICAL ANALYSIS

                3.1.4.3.1   GET STATISTICAL FILES
                3.1.4.3.2   PERFORM STATISTICAL ANALYSIS

            3.1.4.4   DISPLAY MEASUREMENT GRAPHICS

                3.1.4.4.1   GET GRAPHICAL FILES
                3.1.4.4.2   PERFORM GRAPHICAL ANALYSIS

            3.1.4.5   PERFORM REPORT LIBRARY OPERATIONS

                3.1.4.5.1   STORE REPORT
                3.1.4.5.2   RETRIEVE REPORT
                3.1.4.5.3   DELETE REPORT

   3.1.5   EXIT PROGRAM

   4.0   GET MENU SELECTION
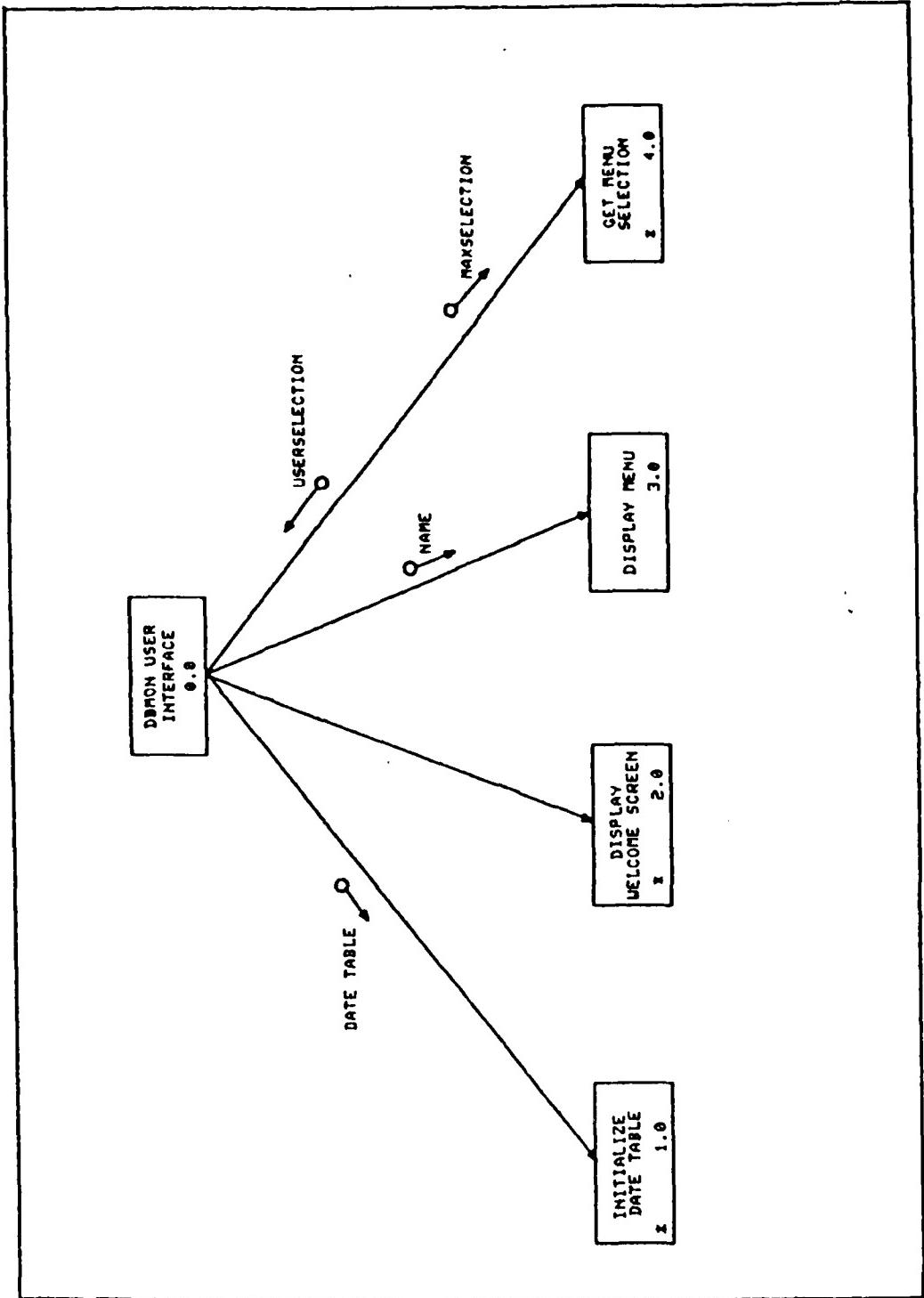
Figure D-1   NODE 0.0 USER INTERFACE
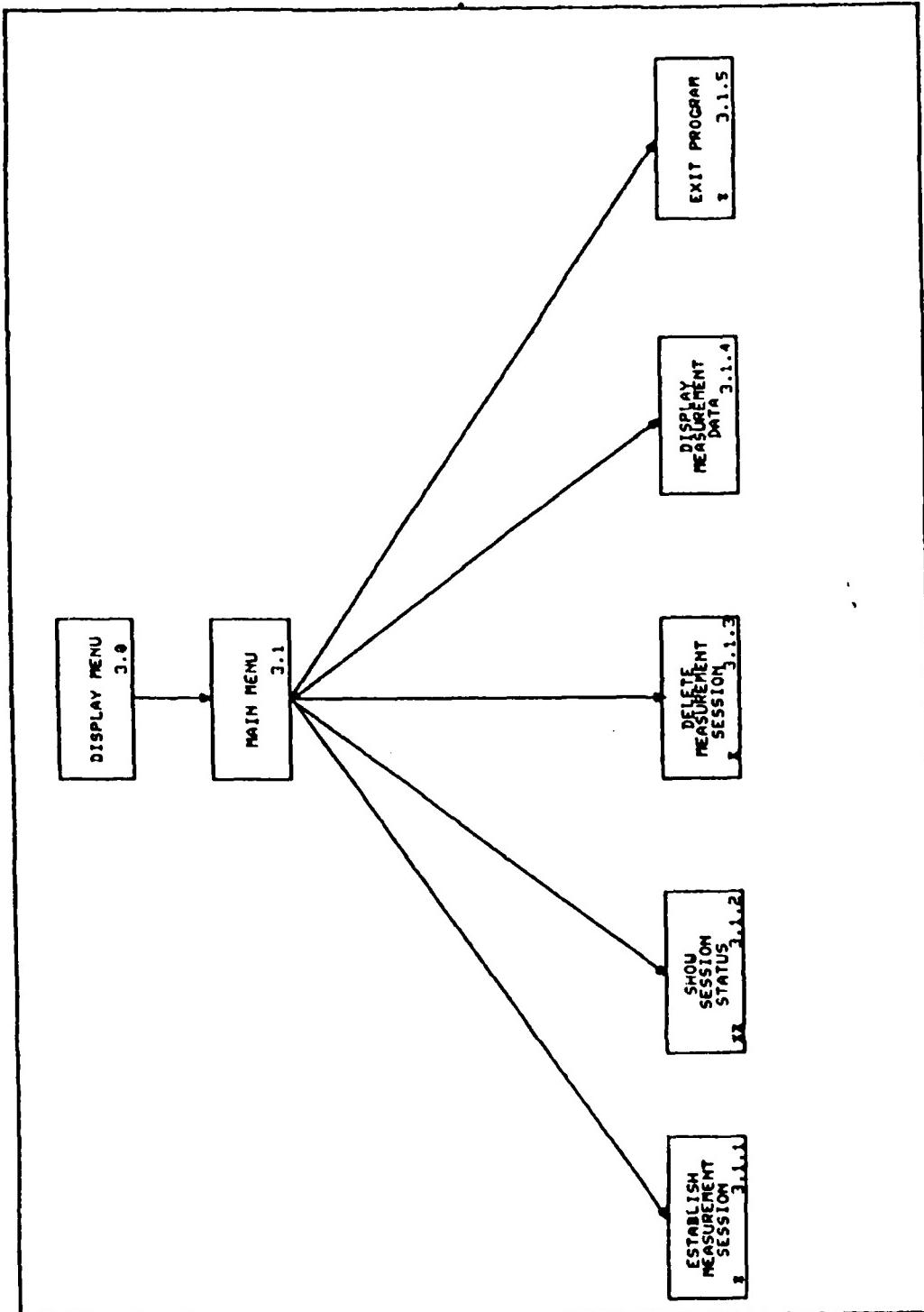
Figure D-2 MODE 3.0 DISPLAY MENU
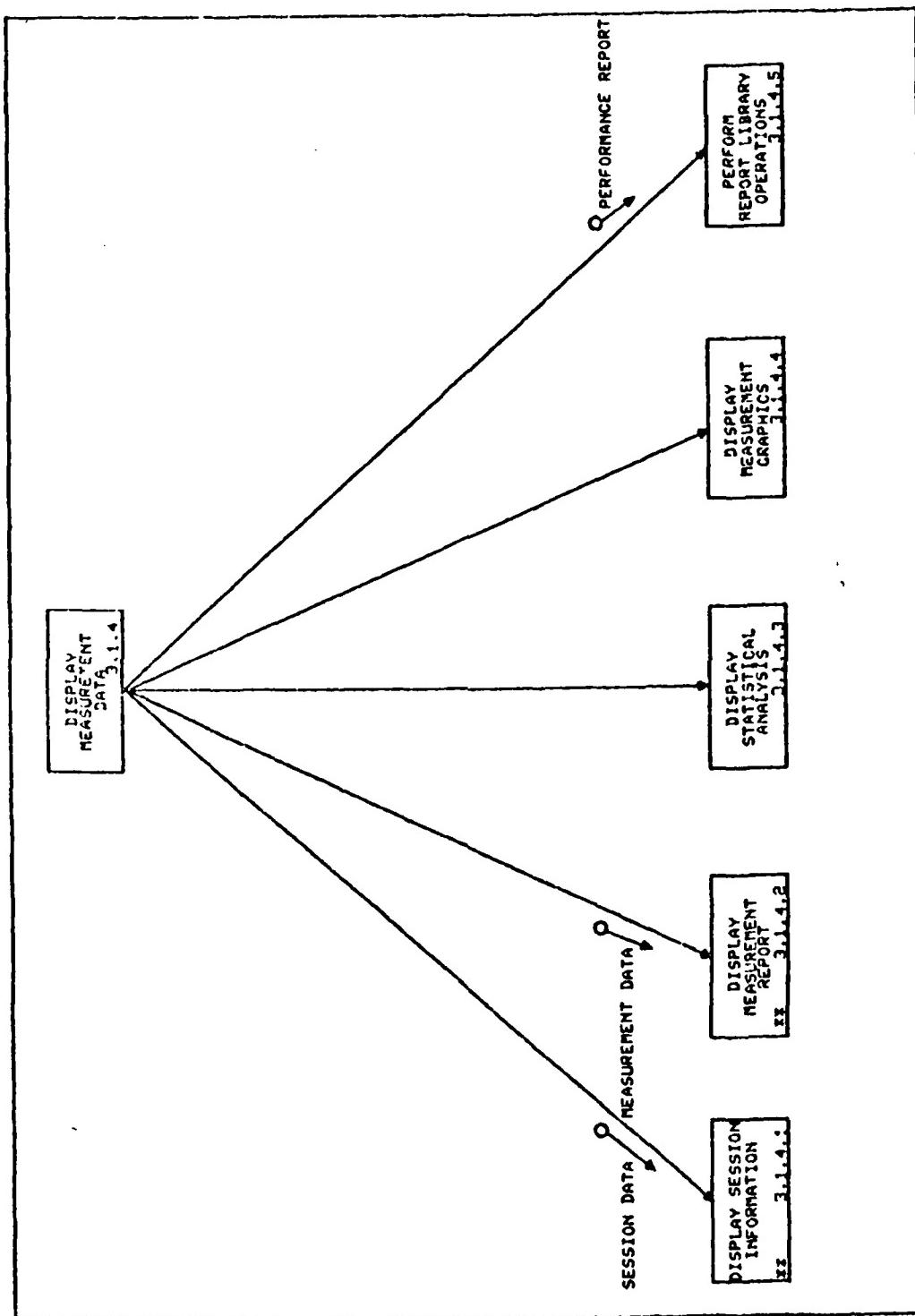
Figure D-3 NODE 3.1.4 DISPLAY MEASUREMENT DATA
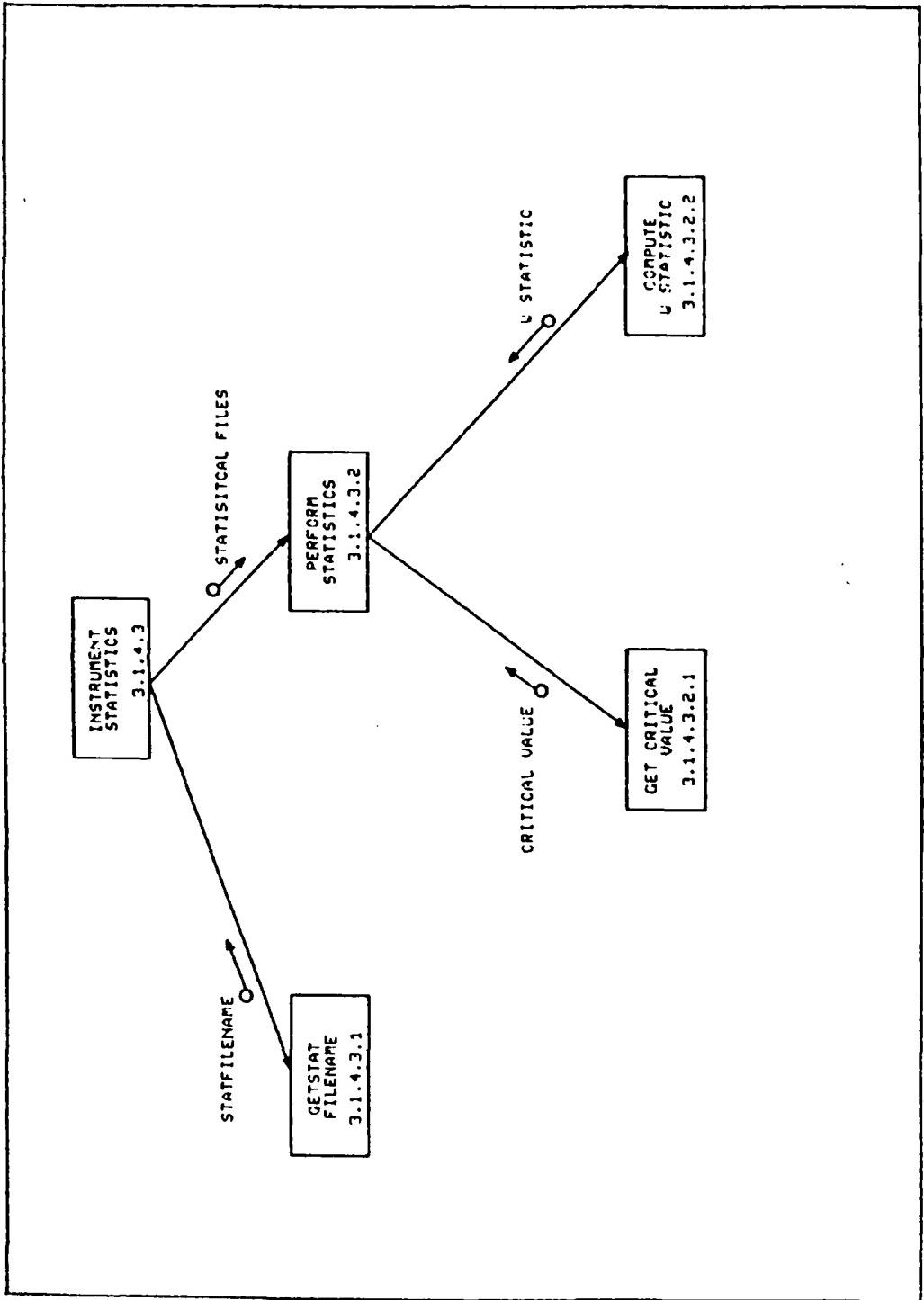
Figure D-4   NODE 3.1.4.3   INSTRUMENT STATISTICS

INSTRUMENT GRAPHICS
3.1.4.4

GRAPHICAL FILES

DISPLAY GRAPHICS
3.1.4.4.1
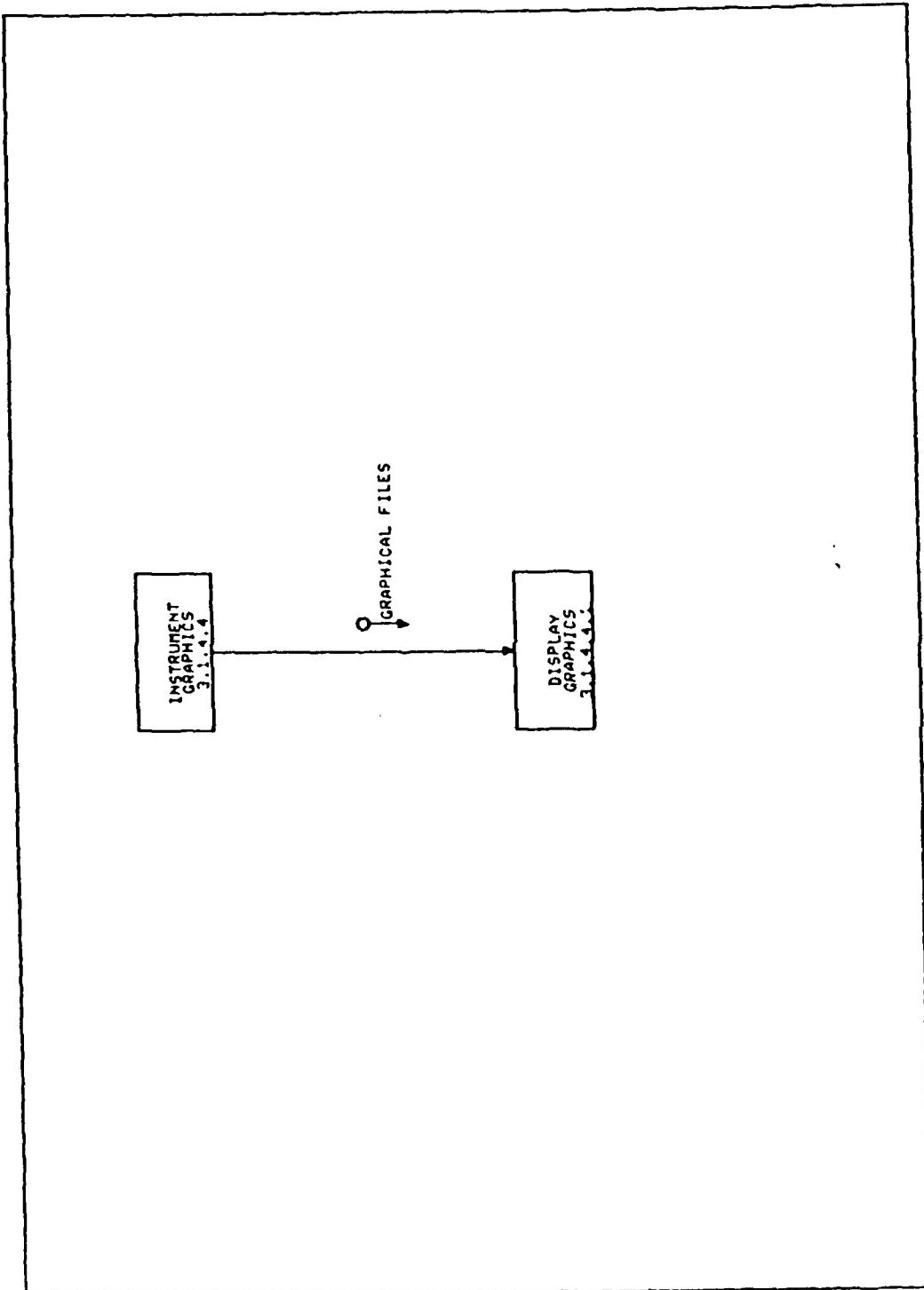
Figure D-5 NODE 3.1.4.4 INSTRUMENT GRAPHICS
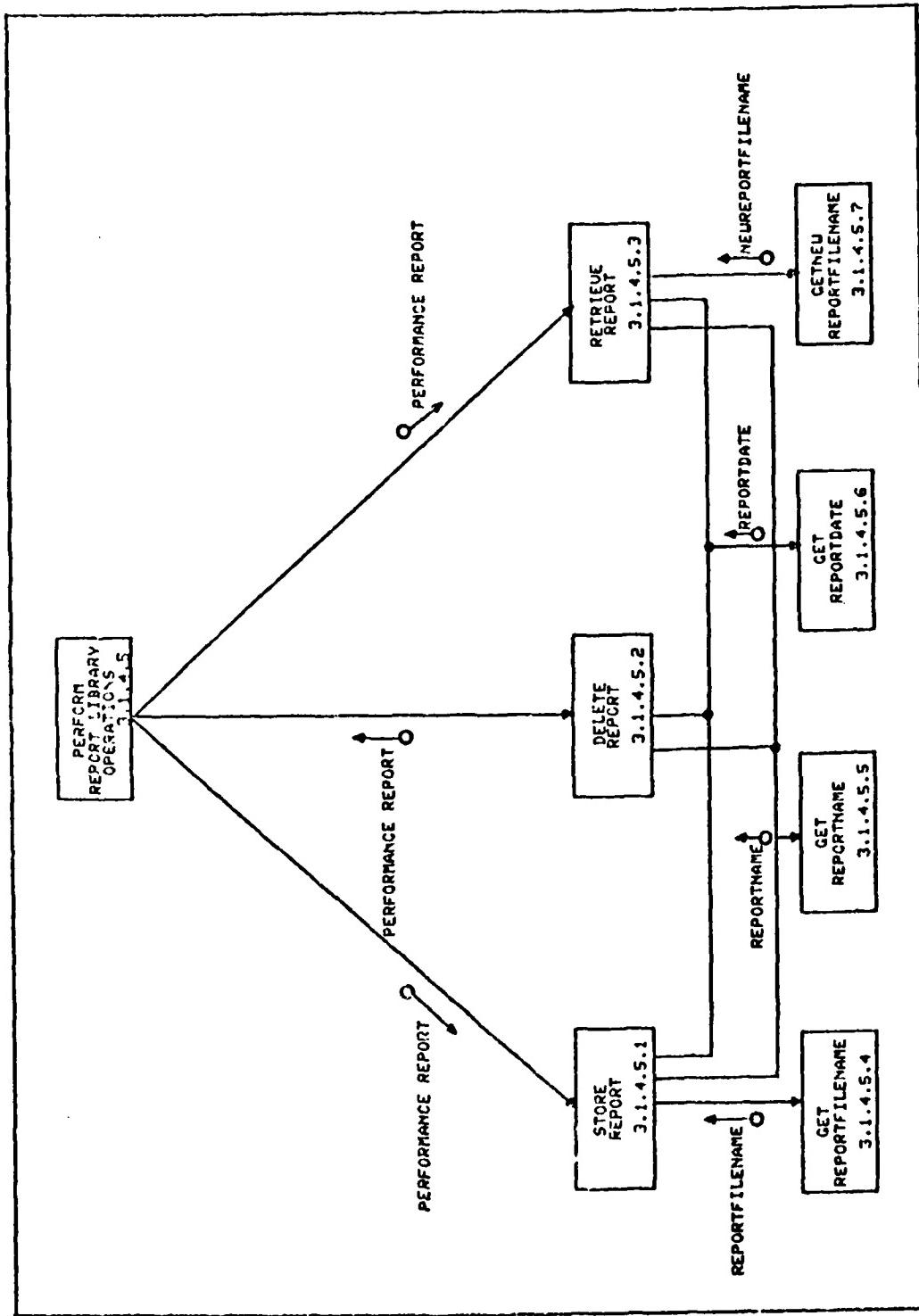
Figure D-6 NODE 3.1.4.5 PERFORM REPORT LIBRARY OPERATIONS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 0.0
NAME: DBMON USER INTERFACE
INPUT DATA: USERSELECTION
INPUT FLAGS: None
OUTPUT DATA: DATE TABLE, NAME, MAXSELECTION
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process is the user interface for the
data base performance monitor.   It establishes the
performance measurement session,   shows the status of the
session,   allows changes to the measurement session, and
analyzes the measurement data.
ALIASES: None
RELATED SADT NUMBER: A0
CALLING PROCESSES: None
PROCESSES CALLED: 1.0, 2.0, 3.0, 4.0
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.0
NAME: INITIALIZE DATE TABLE
INPUT DATA: DATE TABLE
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process initializes the date table used
for the editing of month and day values.
ALIASES: None
RELATED SADT NUMBER: A11
CALLING PROCESSES: 0.0
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 2.0
NAME: DISPLAY WELCOME SCREEN
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process displays the initial screen for
the data base performance monitor user interface.
ALIASES: None
RELATED SADT NUMBER: A1
CALLING PROCESSES: 0.0
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.0
NAME: DISPLAY MENU
INPUT DATA: NAME
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process displays a menu to the user of
the data base performance monitor.
ALIASES: None
RELATED SADT NUMBER: A16
CALLING PROCESSES: 0.0
PROCESSES CALLED: 3.1
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 4.0
NAME: GET MENU SELECTION
INPUT DATA: MAXSELECTION
INPUT FLAGS: None
OUTPUT DATA: USERSELECTION
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process reads and edits user menu
selections.
ALIASES: None
RELATED SADT NUMBER: All
CALLING PROCESSES: 0.0
PROCESSES CALLED: See Reference 2
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1
NAME: MAIN MENU
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process displays the top level menu for
the data base performance monitor user interface.
ALIASES: None
RELATED SADT NUMBER: A1
CALLING PROCESSES: 3.0
PROCESSES CALLED: 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.1
NAME: ESTABLISH MEASUREMENT SESSION
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process allows the user to establish the
data base performance monitor session.
ALIASES: None
RELATED SADT NUMBER: A2
CALLING PROCESSES: 3.1
PROCESSES CALLED: See Reference 2
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.2
NAME: SHOW SESSION STATUS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process displays the status of the
current measurement session to the monitor user.
ALIASES: None
RELATED SADT NUMBER: A1
CALLING PROCESSES: 3.1
PROCESSES CALLED: See Reference 5
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.3
NAME: ESTABLISH MEASUREMENT SESSION
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process allows the user to delete the
current data base performance monitor session.
ALIASES: None
RELATED SADT NUMBER: A1
CALLING PROCESSES: 3.1
PROCESSES CALLED: See Reference 5
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4
NAME: DISPLAY MEASUREMENT DATA
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: MEASUREMENT DATA
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process allows the user to analyze and
display performance measurement data.
ALIASES: None
RELATED SADT NUMBER: A4
CALLING PROCESSES: 3.1
PROCESSES CALLED: 3.1.4.1, 3.1.4.2, 3.1.4.3, 3.1.4.4,
3.1.4.5
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

```
TYPE:  PROCESS
DATE:  6 AUG 1985
NUMBER:  3.1.5
NAME:  EXIT PROGRAM
INPUT DATA:  None
INPUT FLAGS:  None
OUTPUT DATA:  None
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process ends execution of the data base
performance monitor user interface.
ALIASES:  None
RELATED SADT NUMBER:  A1
CALLING PROCESSES:  3.1
PROCESSES CALLED:  See Reference 2
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  Terminal
```

```
TYPE:  PROCESS
DATE:  6 AUG 1985
NUMBER:  3.1.4.1
NAME:  DISPLAY SESSION INFORMATION
INPUT DATA:  None
INPUT FLAGS:  None
OUTPUT DATA:  None
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process displays information about the
current monitor session.
ALIASES:  None
RELATED SADT NUMBER:  A4
CALLING PROCESSES:  3.1.4
PROCESSES CALLED:  None
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  Terminal
```

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.2
NAME: DISPLAY MEASUREMENT REPORT
INPUT DATA: MEASUREMENT DATA
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process produces and displays the
consolidated data base performance measurement report.
ALIASES: None
RELATED SADT NUMBER: A4
CALLING PROCESSES: 3.1.4
PROCESSES CALLED: See Reference 5
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.3
NAME: DISPLAY STATISTICAL ANALYSIS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process generates and displays the
statistical analysis of performance measurement data.
ALIASES: Instrument Statistics
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4
PROCESSES CALLED: 3.1.4.3.1, 3.1.4.3.2
FILES READ: STATISTICAL ANALYSIS FILES
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.4
NAME: DISPLAY MEASUREMENT GRAPHICS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process generates and displays the
graphical presentation of measurement data to the user.
ALIASES: Instrument Graphics
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4
PROCESSES CALLED: 3.1.4.4.1
FILES READ: GRAPHICAL ANALYSIS FILES
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5
NAME: PERFORM REPORT LIBRARY OPERATIONS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process allows the user to establish the
data base performance monitor session.
ALIASES: None
RELATED SADT NUMBER: A42
CALLING PROCESSES: 3.1.4
PROCESSES CALLED: 3.1.4.5.1, 3.1.4.5.2, 3.1.4.5.3
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.3.1
NAME: GETSTATFILENAME
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: STATFILENAME
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process gets the name of a statistical
file to be used in statistical analysis.
ALIASES: None
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4.3
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.3.2
NAME: PERFORM STATISTICS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process performs the requested
statistical analysis.
ALIASES: None
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4.3
PROCESSES CALLED: None
FILES READ: STATISTICAL FILES
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.3.2.1
NAME: GET CRITICAL VALUE
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: CRITICAL VALUE
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process computes the critical value C
used in the Wilcoxon Rank-Sum Test.
ALIASES: None
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4.3.2
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.3.2.2
NAME: COMPUTE W STATISTIC .
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: W STATISTIC
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process computes the W value used in the
Wilcoxon Rank-Sum Test.
ALIASES: None
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4.3.2
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.4.1
NAME: DISPLAY GRAPHICS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process displays the graphical files as a
bar graph upon the user's terminal.
ALIASES: None
RELATED SADT NUMBER: A32
CALLING PROCESSES: 3.1.4.4
PROCESSES CALLED: None
FILES READ: GRAPHICAL FILES
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.1
NAME: STORE REPORT
INPUT DATA: PERFORMANCE REPORT
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process stores measurement reports into
the performance report library.
ALIASES: None
RELATED SADT NUMBER: A421
CALLING PROCESSES: 3.1.4.5
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.2
NAME: RETRIEVE REPORT
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: PERFORMANCE REPORT
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process retrieves the requested
performance report from the performance report library.
ALIASES: None
RELATED SADT NUMBER: A422
CALLING PROCESSES: 3.1.4.5
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: Terminal

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.3
NAME: DELETE REORT
INPUT DATA: PERFORMANCE REPORT
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process deletes the specified performance
report from the performance report library.
ALIASES: None
RELATED SADT NUMBER: A423
CALLING PROCESSES: 3.1.4.5
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: Terminal

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.4
NAME: GETREPORTFILENAME
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: REPORTFILENAME
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process gets the name of a performance
report from the user.
ALIASES: None
RELATED SADT NUMBER: A42
CALLING PROCESSES: 3.1.4.5.1
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.5
NAME: GETREPORTNAME
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: REPORTNAME
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process gets a report title from the
user.
ALIASES: None
RELATED SADT NUMBER: A42
CALLING PROCESSES: 3.1.4.5.1, 3.1.4.5.2, 3.1.4.5.3
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.6
NAME: GETREPORTDATE
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: REPORTDATE
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process gets the report date from the
user.
ALIASES: None
RELATED SADT NUMBER: A42
CALLING PROCESSES: 3.1.4.5.1, 3.1.4.5.2, 3.1.4.5.3
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.1.4.5.7
NAME: GETNEWREPORTFILENAME
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: NEWREPORTFILENAME
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process gets the new report file name
from the user.
ALIASES: None
RELATED SADT NUMBER: A42
CALLING PROCESSES: 3.1.4.5.3
PROCESSES CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: Terminal
HARDWARE WRITTEN: None

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: CRITICAL VALUE
PASSED FROM: 3.1.4.3.2.2
PASSED TO: 3.1.4.3.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a statistical value used in
the Wilcoxon Rank-Sum Test.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Numeric
VALUES: 1 to maximum value of statistic.
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: DATE TABLE
PASSED FROM: 0.0
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is used to edit the day and
month inputs from the user.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Array
VALUES: Numeric, String
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: GRAPHICAL FILES
PASSED FROM: 3.1.4.4.1, 3.1.4.4
PASSED TO: 3.1.4.4, 3.1.4.4.2
COMPOSITION: N/A
DESCRIPTION: This parameter consists of raw graphical files
ready for graphical analysis.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Numeric
RELATED SADT ELEMENTS: GRAPHICAL ANALYSIS FILES
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: MAXSELECTION
PASSED FROM: 0.0
PASSED TO: 4.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the maximum number of
selections allowed for a particular menu.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Character
VALUES: 1 to maximum number of menu selections
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: MEASUREMENT DATA
PASSED FROM: 3.1.4, 3.1.4.1, 3.1.4.2
PASSED TO: 3.1.4.1, 3.1.4.2
COMPOSITION: N/A
DESCRIPTION: This parameter is the performance measurement
data produced by a measurement session of the monitor.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Character, Numeric
ctions
RELATED SADT ELEMENTS: MEASUREMENT DATA FILES
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: NAME
PASSED FROM: 0.0
PASSED TO: 3.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the next menu to
be displayed on the terminal.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Scaler
VALUES: MENUNAME
RELATED SADT ELEMENTS: NEXT SCREEN FORMAT
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: NEWREPORTFILENAME
PASSED FROM: 3.1.4.5.7
PASSED TO: 3.1.4.5.3
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of a file that is
to contain a report.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: PERFORMANCE REPORT
PASSED FROM: 3.1.4
PASSED TO: 3.1.4.5
COMPOSITION: N/A
DESCRIPTION: This parameter is any of the performance
measurement reports produced by the monitor.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Character, Numeric
RELATED SADT ELEMENTS: PERFORMANCE MEASUREMENT REPORT
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: REPORTDATE
PASSED FROM: 3.1.4.5.6
PASSED TO: 3.1.4.5.1, 3.1.4.4.2, 3.1.4.5.3
COMPOSITION: N/A
DESCRIPTION: This parameter is the date of a performance
report.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character, Numeric
RELATED SADT ELEMENTS: None
IS FILES
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: REPORTFILENAME
PASSED FROM: 3.1.4.5.4
PASSED TO: 3.1.4.5.1
COMPOSITION: N/A
DESCRIPTION: This parameter is a name of a file that
contains a performance report.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

DATE: 6 AUG 1985
NAME: REPORTNAME
PASSED FROM: 3.1.4.5.5
PASSED TO: 3.1.4.5.1, 3.1.4.5.2, 3.1.4.5.3
COMPOSITION: N/A
DESCRIPTION: This parameter is the title of a performance
report.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: SESSION DATA
PASSED FROM: 3.1.4
PASSED TO: 3.1.4.1
COMPOSITION: N/A
DESCRIPTION: This parameter is the session specifications
obtained from the monitor user.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Character, Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: STATFILENAME
PASSED FROM: 3.1.4.3.1
PASSED TO: 3.1.4.3
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of a statistical
analysis file.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: STATISTICAL FILES
PASSED FROM: 3.1.4.3
PASSED TO: 3.1.4.3.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a file of statistical raw
data produced by the data analysis program.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Numeric
RELATED SADT ELEMENTS: STATISTICAL ANALYSIS FILES
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: USERSELECTION
PASSED FROM: 4.0
PASSED TO: 0.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the user input from a menu
selection.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Character
VALUES: Alphabet
RELATED SADT ELEMENTS: USER INPUT
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: W STATISTIC
PASSED FROM: 3.1.4.3.2.2
PASSED TO: 3.1.4.3.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a statistical value used in the Wilcoxon Rank-Sum Test.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Numeric
VALUES: 1 to maximum value.
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

Instrumentation Utility Chart Index

1.0   INITUTILITY

2.0   ENDMEASURE

3.0   MEASUREDBMS

4.0   FINDPID

5.0   FILEHANDLER

6.0   GETDATA

7.0   SSERROR
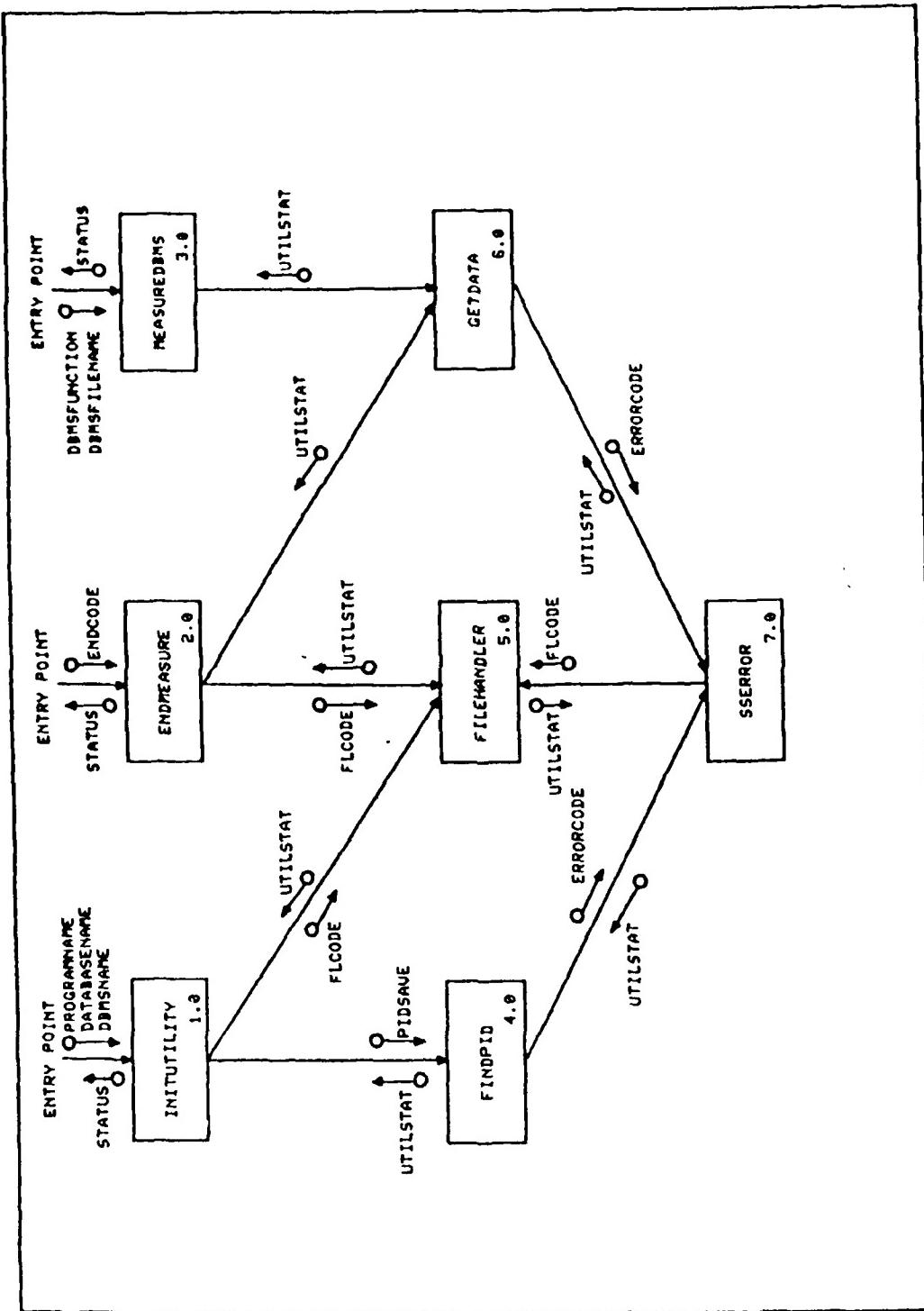
Figure D-7 INSTRUMENTATION UTILITY

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  1.0
NAME:    INITUTILITY
INPUT DATA:  PROGRAMNAME, DATABASENAME, DBMSNAME
INPUT FLAGS:  None
OUTPUT DATA:  STATUS
OUTPUT FLAGS:  None
GLOBAL DATA USED:  DBUFF, UTILSTAT
GLOBAL DATA CHANGED:  DBUFF, UTILSTAT
DESCRIPTION:  This process is the entry point for using the
instrumentation utility.  It enables the utility by finding
the DBMS's process id, creating a data file, and recording
the calling program name and data base name.
ALIASES:  None
RELATED SADT NUMBER:  A23
CALLING PROCESS:  None
PROCESS CALLED:  4.0, 5.0
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None


TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  2.0
NAME:    ENDMEASURE
INPUT DATA:  ENDCODE
INPUT FLAGS:  None
OUTPUT DATA:  STATUS
OUTPUT FLAGS:  None
GLOBAL DATA USED:  DBUFF, UTILSTAT, FLCODE
GLOBAL DATA CHANGED:  DBUFF, UTILSTAT, FCODE
DESCRIPTION:  This process records the state of the DBMS
after a DBMS command has been executed.
ALIASES:  None
RELATED SADT NUMBER:  A24
CALLING PROCESS:  None
PROCESS CALLED:  5.0, 6.0
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 3.0
NAME: MEASUREDBMS
INPUT DATA: DBMSFUNCTION, DBMSFILENAME
INPUT FLAGS: None
OUTPUT DATA: STATUS
OUTPUT FLAGS: None
GLOBAL DATA USED: DBUFF, UTILSTAT
GLOBAL DATA CHANGED: DBUFF, UTILSTAT
DESCRIPTION: This process records the status of the DBMS
just before the execution of a DBMS command.
ALIASES: None
RELATED SADT NUMBER: A24
CALLING PROCESS: None
PROCESS CALLED: 6.0
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 4.0
NAME: FINDPID
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: PIDSAVE, DBMSNAME, UTILSTAT
GLOBAL DATA CHANGED: PIDSAVE
DESCRIPTION: This process searches the list of active
process to find the pid of the DBMS that is being measured
by the monitor instumentation utility.
ALIASES: None
RELATED SADT NUMBER: A24
CALLING PROCESS: 1.0
PROCESS CALLED: 7.0
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  5.0
NAME:    FILEHANDLER
INPUT DATA:    FLCODE
INPUT FLAGS:   None
OUTPUT DATA:   None
OUTPUT FLAGS:  None
GLOBAL DATA USED:    UTILSTAT
GLOBAL DATA CHANGED:  UTILSTAT
DESCRIPTION:  This process handles all operations related to
the output of the instrument data file.
ALIASES:  None
RELATED SADT NUMBER:  A24
CALLING PROCESS:  1.0, 2.0, 7.0
PROCESS CALLED:  None
FILES READ:  None
FILES WRITTEN:  INSTRUMENATATION DATA FILE
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  6.0
NAME:    GETDATA
INPUT DATA:    None
INPUT FLAGS:   None
OUTPUT DATA:   None
OUTPUT FLAGS:  None
GLOBAL DATA USED:    PIDSAVE, UTILSTAT
GLOBAL DATA CHANGED:  UTILSTAT
DESCRIPTION:  This process retrieves the performance data
from the system tables.
ALIASES:  None
RELATED SADT NUMBER:  A24
CALLING PROCESS:  2.0, 3.0
PROCESS CALLED:  7.0
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

```
TYPE:   PROCESS
DATE:   6 AUG 1985
NUMBER:  7.0
NAME:   SSERROR
INPUT DATA:  SYSTEM ERROR CODES
INPUT FLAGS:  None
OUTPUT DATA:  None
OUTPUT FLAGS:  None
GLOBAL DATA USED:  FLCODE, UTILSTAT
GLOBAL DATA CHANGED:  FLCODE, UTILSTAT
DESCRIPTION:  This process handles error conditions returned
by system routines.
ALIASES:  None
RELATED SADT NUMBER:  A24
CALLING PROCESS:  4.0, 6.0
PROCESS CALLED:  5.0
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: DATABASENAME
PASSED FROM: Calling Program
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the data base
being accessed by the application program being monitored.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: DBMSFILENAME
PASSED FROM: Calling Program
PASSED TO: 3.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the file within
the DBMS that is being accessed by the application program.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: DBMSFUNCTION
PASSED FROM: Calling Program
PASSED TO: 3.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the DBMS command
that is being measured.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: DBMSNAME
PASSED FROM: Calling Program
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the DBMS that is
being monitored.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: ENDCODE
PASSED FROM: Calling Program
PASSED TO: 2.0
COMPOSITION: N/A
DESCRIPTION: This parameter indicates if the
instrumentation utility is to be disabled or not.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: ERRORCODE
PASSED FROM: 4.0, 5.0
PASSED TO: 7.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the error that
has occured.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: FLCODE
PASSED FROM: 1.0, 2.0, 7.0
PASSED TO: 5.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the function code for the
filehandler process.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: PIDSAVE
PASSED FROM: 1.0
PASSED TO: 4.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the DBMS process id.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: PROGRAMNAME
PASSED FROM: Calling Program
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is name of the calling
application program.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: STATUS
PASSED FROM: 1.0, 2.0, 3.0
PASSED TO: Calling Program
COMPOSITION: N/A
DESCRIPTION: This parameter indicates the status of the
previous instrumentation utility operation.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: UTILSTAT
PASSED FROM: 4.0, 5.0, 6.0, 7.0
PASSED TO: 1.0, 2.0, 3.0, 4.0, 6.0, 7.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the current status of the
instrumentation utility.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

Data Analysis Program Chart Index

Figure D-8 DATA ANALYSIS PROGRAM
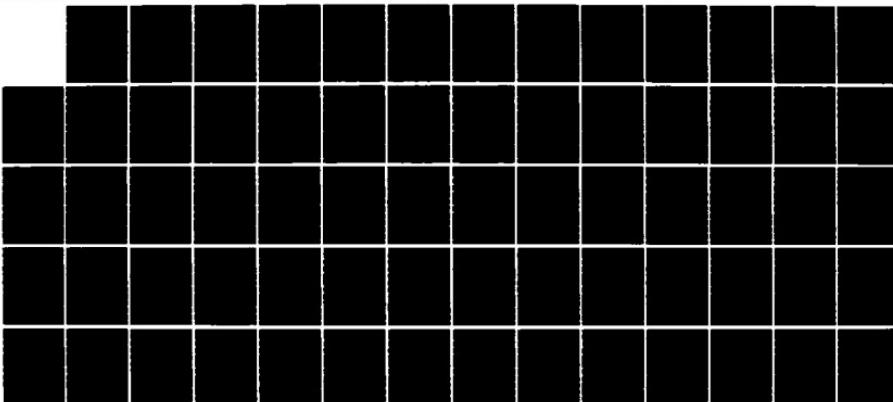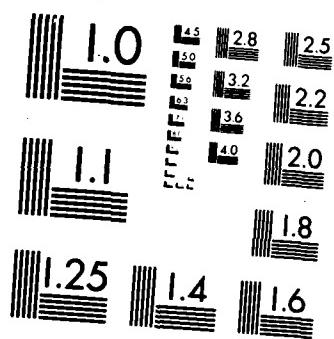
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A
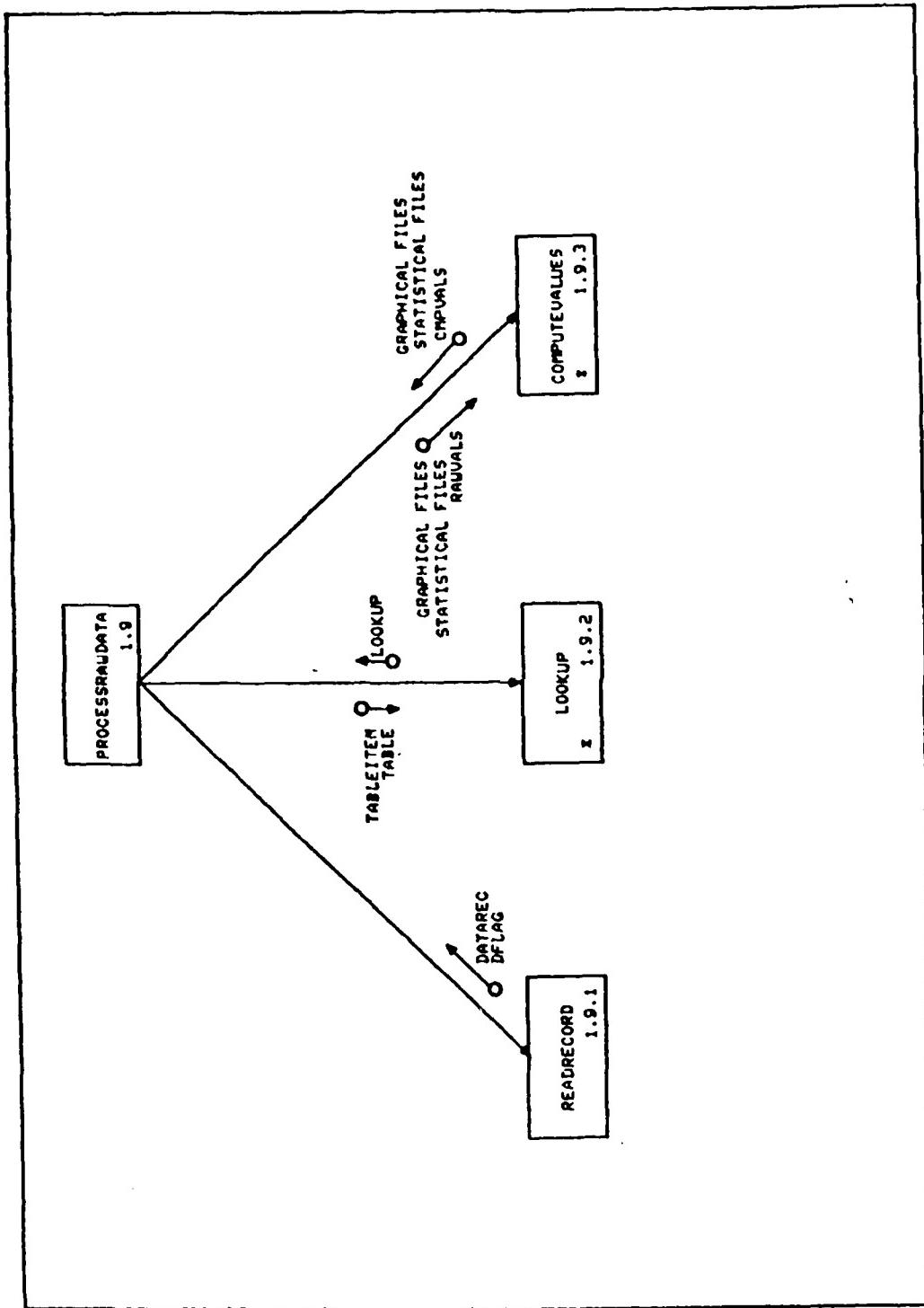
Figure D-9 NODE: 1.9 PROCESSRAWDATA

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  1.0
NAME:    MAIN DRIVER
INPUT DATA:  None
INPUT FLAGS:  None
OUTPUT DATA:  None
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process is the main driver for the data
analysis program.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  None
PROCESS CALLED:  1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8,
1.9, 1.10, 1.11
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  1.1
NAME:    DISPLAY MENU
INPUT DATA:  None
INPUT FLAGS:  None
OUTPUT DATA:  SELECTION
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process displays the main menu of the
data analysis program.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.0
PROCESS CALLED:  None
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  Terminal
HARDWARE WRITTEN:  Terminal
```

```
TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  1.2
NAME:    CREATELISTS
INPUT DATA:  RETRIEVE, STORAGE, CONTROL, SPECIALPURP
INPUT FLAGS:  None
OUTPUT DATA:  RETRIEVE, STORAGE, CONTROL, SPECIALPURP
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process creates four lists of DML
commands based on their type.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.0
PROCESS CALLED:  None
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None


TYPE:    PROCESS
DATE:    6 AUG 1985
NUMBER:  1.3
NAME:    INITBUFF
INPUT DATA:  DBUFF
INPUT FLAGS:  None
OUTPUT DATA:  DBUFF
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process initializes the contents of the
DML data buffer to zero.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.0
PROCESS CALLED:  None
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

SYSTEM DESIGN DOCUMENTATION - STRUCTURE CHARTS

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.4
NAME: INITABLE
INPUT DATA: TABLE
INPUT FLAGS: None
OUTPUT DATA: TABLE
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process initializes the DML data table to
zero.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.5
NAME: DATAINTABLE
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: Boolean value of true or false
OUTPUT FLAGS: None
GLOBAL DATA USED: PRGINFO, INVINFO
GLOBAL DATA CHANGED: None
DESCRIPTION: This process determines if a table is empty or
not.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.6
NAME: INITSTATISTICS
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: STATISTICAL FILES
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process initializes the statistical files
if requested.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.7
NAME: CREATETABLE
INPUT DATA: None
INPUT FLAGS: None
OUTPUT DATA: TABLE
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process creates a table of DML commands.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: See Reference 1
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

```
TYPE:   PROCESS
DATE:   6 AUG 1985
NUMBER:  1.8
NAME:   SESSIONTOTALS
INPUT DATA:  PRGINFO, INVINFO
INPUT FLAGS:  None
OUTPUT DATA:  SUMINFO, SUMINVINFO
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process accumulates overall totals for
the measurement session.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.0
PROCESS CALLED:  See Reference 1
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

```
TYPE:   PROCESS
DATE:   6 AUG 1985
NUMBER:  1.9
NAME:   PROCESSRAWDATA
INPUT DATA:  PRGINFO, INVINFO
INPUT FLAGS:  None
OUTPUT DATA:  STATISTICAL FILES, GRAPHICAL FILES,
CURRPRGNAME, DFLAG
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process controls the reading of raw data
files and their processing.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.0
PROCESS CALLED:  1.9.1, 1.9.2, 1.9.3
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.10
NAME: PRINTSUMMARY
INPUT DATA: PRGINFO, INVINFO, PROGNAME
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process prints the summary report.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: See Reference 1
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.11
NAME: COMPUTEGRAPHDATA
INPUT DATA: GRAPHICAL FILES
INPUT FLAGS: None
OUTPUT DATA: GRAPHICAL FILES
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process configures the graphical data
into a form required by the graphical analysis program.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.0
PROCESS CALLED: None
FILES READ: None
FILES WRITTEN: None
HARDWARE READ: None
HARDWARE WRITTEN: None

```
TYPE:  PROCESS
DATE:  6 AUG 1985
NUMBER:  1.9.1
NAME:  READRECORD
INPUT DATA:  None
INPUT FLAGS:  None
OUTPUT DATA:  DATAREC, DFLAG
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process reads a record from the input
data file.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.9
PROCESS CALLED:  None
FILES READ:  Raw Performance Data
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

```
TYPE:  PROCESS
DATE:  6 AUG 1985
NUMBER:  1.9.2
NAME:  LOOKUP
INPUT DATA:  TABLE, TABLEITEM
INPUT FLAGS:  None
OUTPUT DATA:  LOOKUP
OUTPUT FLAGS:  None
GLOBAL DATA USED:  None
GLOBAL DATA CHANGED:  None
DESCRIPTION:  This process finds the position of an item in
a table.
ALIASES:  None
RELATED SADT NUMBER:  A3
CALLING PROCESS:  1.9
PROCESS CALLED:  See Reference 1
FILES READ:  None
FILES WRITTEN:  None
HARDWARE READ:  None
HARDWARE WRITTEN:  None
```

TYPE: PROCESS
DATE: 6 AUG 1985
NUMBER: 1.9.3
NAME: COMPUTEVALUES
INPUT DATA: RAWVALS
INPUT FLAGS: None
OUTPUT DATA: None
OUTPUT FLAGS: None
GLOBAL DATA USED: None
GLOBAL DATA CHANGED: None
DESCRIPTION: This process computes the values of the
performance parameters and records them in the statistical
and graphical files.
ALIASES: None
RELATED SADT NUMBER: A3
CALLING PROCESS: 1.9
PROCESS CALLED: See Reference 1
FILES READ: None
FILES WRITTEN: STATISTICAL FILES, GRAPHICAL FILES
HARDWARE READ: None
HARDWARE WRITTEN: None

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: CONTROL
PASSED FROM: 1.0, 1.2
PASSED TO: 1.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a list of DML control
commands.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Array
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: CMPVALS
PASSED FROM: 1.9.3
PASSED TO: 1.9
COMPOSITION: N/A
DESCRIPTION: This parameter is computed performance data.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Record
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: CURRPRGNAME
PASSED FROM: 1.9
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the name of the DBMS
application program that is currently being evaluated.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: String
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

```
TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    DATAREC
PASSED FROM:  1.9.1
PASSED TO:  1.9
COMPOSITION:  N/A
DESCRIPTION:  This parameter is a record of raw data.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Record
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed


TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    DBUFF
PASSED FROM:  1.0, 1.3
PASSED TO:  1.3
COMPOSITION:  N/A
DESCRIPTION:  This parameter is a DML data buffer area.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Array
VALUES:  Character
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed


TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    DFLAG
PASSED FROM:  1.9.1
PASSED TO:  1.9
COMPOSITION:  N/A
DESCRIPTION:  This parameter indicates end of file for the
raw measurement data file.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Integer
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed
```

```
TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    GRAPHICAL FILES
PASSED FROM:  1.0, 1.9.3, 1.11
PASSED TO:  1.0, 1.9.3
COMPOSITION:  N/A
DESCRIPTION:  This parameter is the file of graphical data.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  File
VALUES:  Numeric
RELATED SADT ELEMENTS:  GRAPHICAL ANALYSIS FILES
STORAGE TYPE:  Global


TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    INVINFO
PASSED FROM:  1.0
PASSED TO:  1.5, 1.8, 1.9, 1.10
COMPOSITION:  N/A
DESCRIPTION:  This parameter is DML performance data.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Record
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed


TYPE:    PARAMETER
DATE:    6 AUG 1985
NAME:    LOOKUP
PASSED FROM:  1.9.2
PASSED TO:  1.9
COMPOSITION:  N/A
DESCRIPTION:  This parameter is the location of an item in a
table.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Integer
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed
```

```
TYPE:   PARAMETER
DATE:   6 AUG 1985
NAME:   PROGNAME
PASSED FROM:  1.0
PASSED TO:  1.11
COMPOSITION:  N/A
DESCRIPTION:  This parameter is the name of the program
whose data is to be printed.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  String
VALUES:  Character
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed
```

```
TYPE:   PARAMETER
DATE:   6 AUG 1985
NAME:   PRGINFO
PASSED FROM:  1.0
PASSED TO:  1.5, 1.8, 1.9, 1.10
COMPOSITION:  N/A
DESCRIPTION:  This parameter is DML performance data.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Record
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed
```

```
TYPE:   PARAMETER
DATE:   6 AUG 1985
NAME:   RAWVALS
PASSED FROM:  1.9
PASSED TO:  1.9.3
COMPOSITION:  N/A
DESCRIPTION:  This parameter is a record of raw performance
data.
ALIASES:  None
PART OF:  N/A
DATA CHARACTERISTICS:  Record
VALUES:  Numeric
RELATED SADT ELEMENTS:  None
STORAGE TYPE:  Passed
```

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: RETRIEVE
PASSED FROM: 1.0, 1.2
PASSED TO: 1.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a the list of DML retrieval
commands.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Array
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: SELECTION
PASSED FROM: 1.1
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the user menu selection.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Integer
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: SPECIALPURP
PASSED FROM: 1.0, 1.2
PASSED TO: 1.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a list of DML special
purpose commands.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Array
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: STATISTICAL FILES
PASSED FROM: 1.0, 1.6, 1.9, 1.93
PASSED TO: 1.6, 1.9.3
COMPOSITION: N/A
DESCRIPTION: This parameter is the file containing data to
be used for statistical analysis.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: File
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Global

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: STORAGE
PASSED FROM: 1.0, 1.2
PASSED TO: 1.2
COMPOSITION: N/A
DESCRIPTION: This parameter is a the list of DML storage
commands.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Array
VALUES: Character
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: SUMINVINFO
PASSED FROM: 1.8
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the totaled performance
data.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Record
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: SUMINFO
PASSED FROM: 1.8
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is the summary record of
performance data.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Record
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: TABLE
PASSED FROM: 1.0, 1.4
PASSED TO: 1.0, 1.4
COMPOSITION: TABLEITEM
DESCRIPTION: This parameter is a table of DML commands.
ALIASES: None
PART OF: N/A
DATA CHARACTERISTICS: Record
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

TYPE: PARAMETER
DATE: 6 AUG 1985
NAME: TABLEITEM
PASSED FROM: 1.8
PASSED TO: 1.0
COMPOSITION: N/A
DESCRIPTION: This parameter is an entry in a DML command
table.
ALIASES: None
PART OF: TABLE
DATA CHARACTERISTICS: Record
VALUES: Numeric
RELATED SADT ELEMENTS: None
STORAGE TYPE: Passed

Appendix E

DBMON User's Guide

Table of Contents

SECTION III - DBMON User's Methodology

Introduction

This appendix contains the DBMON User's Guide. It presents the required setup for using DBMON, and the operating instructions for the operation of DBMON, Version 3.0. The use of the monitor is also explained as part of the DBMON User's Methodology, which can be applied to help solve DBMS performance problems.

SECTION I - DBMON SYSTEM DESCRIPTION

Scope

The scope of this user's guide is limited to describing
the operation of DBMON software. The reader should have a
working knowledge of the VAX 11/780 computer, the VMS
operating system, the TOTAL DBMS, and the INGRES DBMS. For
details of the above, consult the INGRES reference manual,
TOTAL reference manual, or the appropriate VAX/VMS manual.

DBMON Description

DBMON (Data Base MOnitor) is a Data Base Management
System Performance Monitor. It is designed to operate with
the TOTAL and INGRES DBMSs on a VAX 11/780 computer running
the VMS operating system.

DBMON may be used to monitor and record system and
performance statistics generated by DBMS commands embedded
in application software. DBMON is not designed for use with
a DBMS that is being used interactively.

The DBMON software system consists of four VAX VMS
utilities and seven programs as illstrated in Figure E-1.
VAX utilities are marked with a (U), while DBMON programs
are marked with a (P).

Conceptually, the DBMON system may be broken into four
functional areas:

(1) User Interface. The user interface is used to specify
a measurement session. A measurement session is the
period of time in which DBMON will be collecting DBMS
performance data. The DBMON user specifies the type of
performance measurement that is required. The user
interface uses these specifications to produce a VMS
command procedure that will control the collection of
system statistics and DBMON execution.

(2) Measure System and DBMS. During this phase, the DBMON
user executes an application program that has embedded
calls to the instrumentation facility thereby producing
one or more raw measurement files. This occurs during a
measurement session initiated by the User Interface. The
instrumentation facility records DBMS performance
statistics while the system utilities are used to record
system performance parameters specified by the user.

(3) Analyze Measurement Data. During this phase the raw
data collected in the previous phase is analyzed and
summarized. VMS utilities are used to extract summarize
the required performance parameter values from the system
accounting and error log files. The raw measurement files
are merged into a single file which is analyzed by the
Data Analysis Program.

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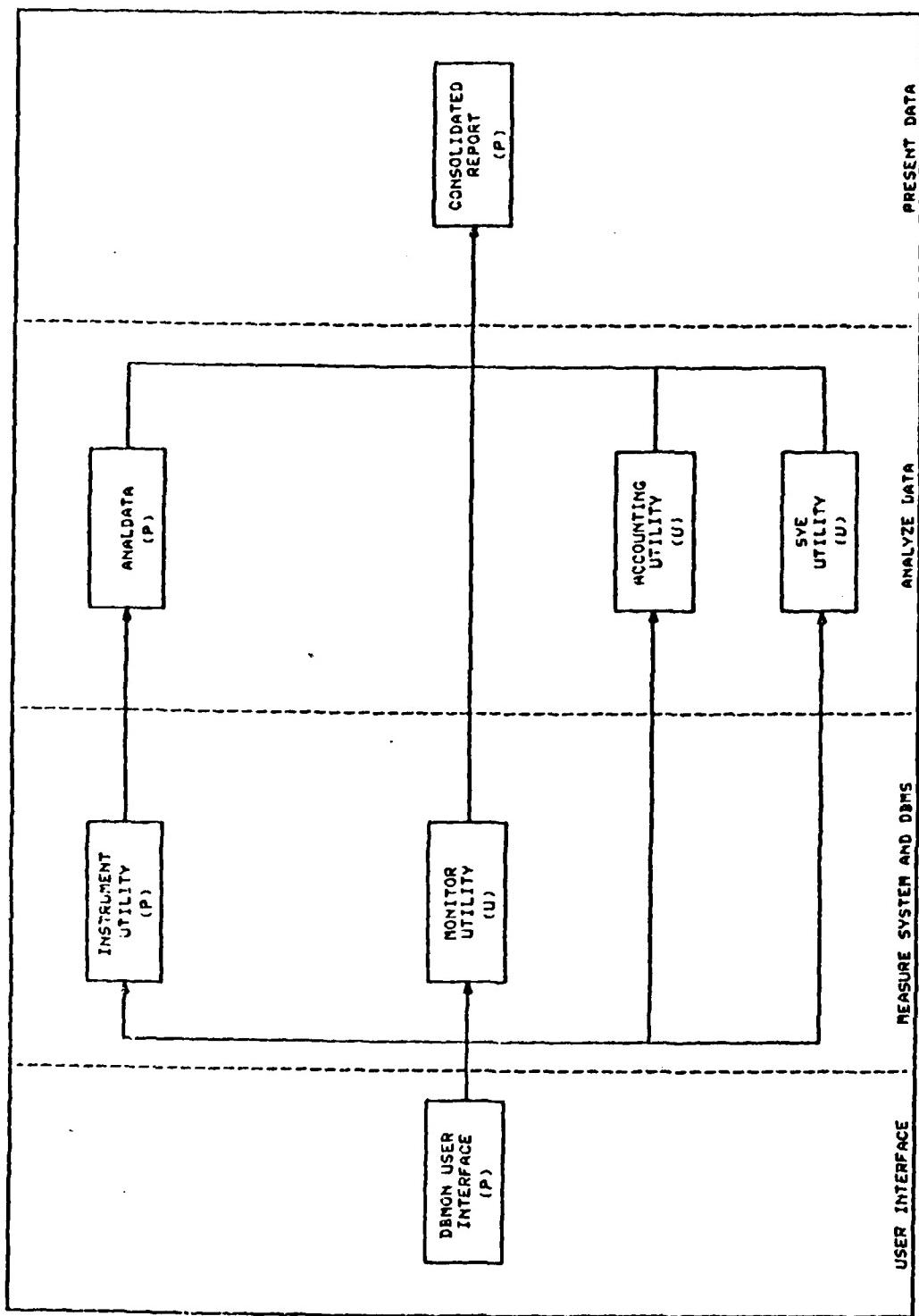
Figure E-1 DBMON SYSTEM COMPOSITION (P - DBMON PROGRAM, U - VAX/VMS UTILITY)

(4) Present Data. This phase consolidates the summary

files into a system performance measurement report.

DBMON Development Status

DBMON Version 3.0 is a complete DBMS performance

monitor. It is capable of providing a detailed view of the

operational performance of the TOTAL and INGRES DBMSs.

Installation Requirements

A target VAX computer for the DBMON system must satisfy

the following requirements:

(1) The VMS operating system must be used.

(2) The Monitor, Accounting, and SYE utilities must be

present.

(3) At least 2000 blocks of availible disk space is

required.

(4) The INGRES DBMS must be availible for DBMON use.

(5) A separate account and directory must be established

for use by the DBMON system.

UIC Requirements

The DBMON system requires system priviliges. This is

because the command procedure generated by the user

interface must access the error log files, which can only be

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accessed by accounts with system priviliges.

There is also a UIC requirement assiciated with the
instrumentation utility. The utility can only be used by
those users with system priviliges, or by those users with
an account that is in the same group as the TOTAL DBMS.

DBMON Directory

The DBMON directory should be established on a disk
volume separate from those containing the TOTAL and INGRES
DBMSs. This will avoid the additional overhead caused by
having both DBMON and the target DBMS contending for the
same disk drive. The UIC of the DBMON directory should be
set so that all users of INGRES and TOTAL have access for
the reading and writing of files within the DBMON directory.
It is recommended that the DBMON directory be in the same
group as the UIC of the TOTAL and INGRES DBMSs.

DBMON Installation

With the creation of the DBMON account and directory,
the DBMON software may be loaded from the BACKUP tape with
the following VMS commands:

```
$MOUNT/FOREIGN <tdev-name>:
$BACKUP <tdev-name>:DBMON.BAK/SELECT=[DBMON]
<ddev-name>:[DBMON]
```

where <tdev-name> is a valid tap device name, and
<ddev-name> is a vaild disk device name. The UIC specified

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should be the same as the UIC the DBMON directory was
created with.

   After the BACKUP command has executed the following
files should be present:

```
ANALDATA.QP
ANALYZE.TXT
DBMON.QP
DBMONINIT.COM
INSTRMNT.TXT
INSTRUTIL.MAR
LIBRARY.TXT
MAIN.TXT
MEASURE.TXT
MERGDATA.PAS
PARAMETER.TXT
PARMFILE.TBL
PRTREPORT.PAS
SCREENLIB.PAS
SESSION.LOG
SETRUN.PAS
SORTINSTR.COM
STATS.TXT
```

   The next step is to examine DBMON.QP, INSTRUTIL.MAR,
SETRUN.PAS, MERGDATA.PAS, PRTREPORT.PAS, and INSTRUTIL.MAR
to ensure file compatability.   In the DBMON.QP file, the
program constraints shown below must be verified to ensure
device name and UIC compatability.


```
ERRORFILES           = 'DUAO:[SYSO.SYSERR]';
DATAFILES            = 'DUA1:[DBMON]';
UICCODE              = '[200,050]';
```

The two OPEN() statements in the program must also be
verified to ensure device name compatability.

   In the INSTRUTIL.MAR program, the following statement
must be verified to ensure device name compatability for the

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DBMON directory.

DATAFILE: $FAB FNM=<DUA1:[DBMON]INSTR.DAT>,FAC=PUT

In the ANALDATA.QP program, the OPEN() statements must
also be checked for device name compatability. If the
device names are incorrect in any of these programs, the
source code must be edited to the proper device names.

The SCREENLIB.PAS program is written to work with VT100
terminals. If the DBMON using computer system does not have
VT100 terminal, SCREENLIB.PAS will have to be examined with
regard to the escape sequences. For example the VT100
escape sequence is: Esc[Pn;Pnf. Pn;Pnf is the ASCII
representation of the row;column of the cursor position.
The following Pascal implementation is used in
SCREENLIB.PAS:

WRITE(CHR(27),'[',ROWTENS,ROWONES,';',COLTENS,COLONES,'f');

Where CHR(27) is the Esc character, and ROWTENS, COLTENS,
ROWONES, and COLONES are variable name representing the
cursor position.

The next installation step is to create executable
files for the programs. The following command sequence will
perform this operation.

```
$EQP DBMON
$EQP ANALDATA
$PAS SCREENLIB
$LINK DBMON,SCREENLIB, -
      DUAO:[INGRES.LIBRARY]LIBQ/LIBRARY, -
      DUAO:[INGRES.LIBRARY]COMPATLIB/LIBRARY
$LINK ANALDATA,SCREENLIB, -
      DUAO:[INGRES.LIBRARY]LIBQ/LIBRARY,-
      DUAO:[INGRES.LIBRARY]COMPATLIB/LIBRARY
$PAS SETRUN
$LINK SETRUN
$PAS MERGDATA
$LINK MERGDATA
$PAS PRTREPORT
$LINK PRTREPORT
$MACRO INSTRUTIL
```

The last installation step is to establish the INGRES
data bases used by the DBMON system. Two data bases are
required; one for the report library; one for the
statistical and graphical analysis files. The following
commands will create these data bases:

```
CREATEDB DBMONLIB
CREATEDB DBMONDATA
```

The following commands will prepare the report library for
use by DBMON.

```
INGRES DBMONLIB
CREATE LIBRARY (REPORT_NAME=C40,
       REPORT_DATE=C7,FILE_NUMBER=I2)/G
CREATE CURRENTFILE (FILE_NUMBER=I2)/G
/Q
```

The following commands will prepare the statistical and
graphical files for use by the DBMON system.

```
INGRES DBMONDATA
CREATE FILELIST (FILENAME=C9)/G
CREATE CPU (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
CREATE BUFIO (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
CREATE DIRIO (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
CREATE PAGEFLTS (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
CREATE WSSIZE (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
CREATE RESPTIME (DBFUNC=C5,VALUE=F4,POSITION=I2)/G
/Q
```

After creating the INGRES DBMONLIB and DBMONDATA data
bases, the following INGRES VMS commands should be executed
in order to improve performance of the data bases.

```
OPTIMIZEDB DBMONLIB
SYSMOD DBMONLIB
OPTIMIZEDB DBMONDATA
SYSMOD DBMONDATA
```

Periodic use of these optimization commands will help ensure
that the INGRES databases used by DBMON are running at their
highest efficiency.

Operational Instructions

The DBMON user interface has been designed around the use of menus and data entry screens. The formats are not reproduced entirely in this manual, but enough information is given in order to clearly describe the screen format being discussed.

Main Menu

The DBMON user works directly with the DBMON and ANALDATA programs. The DBMON programs contains the user interface to the DBMON system. After logging into the DBMON directory, the '$RUN DBMON' command will initiate the DBMON User Interface. The initial screen should specify that Version 3.0 is running. Pushing the return key will bring the user to the main menu:


```
1..SPECIFY MEASURMENT SESSION
2..DELETE MEASUREMENT SESSION
3..SHOW STATUS OF MEASUREMENT SESSION
4..ANALYZE PERFORMANCE DATA
5..HELP FOR THIS MENU
6..EXIT PROGRAM
```

By entering the number of the desired option and then depressing the return key, DBMON will proceed to the requested function.

Option 1 - This allows a measurement session to be specified by guiding the user through a series of menus and data entry prompts. This series is discussed in the SPECIFY MEASUREMENT SESSION section below.

Option 2 - This will allow the user to delete a measurement session that is currently executing or awaiting execution.

Option 3 - This option allows the user to inspect the current status of the performance monitor (i.e. complete, waiting, etc.).

Option 4 - This option allows collected performance measurements to be displayed as a report, displayed graphically, or statistically analyzed. This section also provides access to the report library. Further detail is provided in the Analyzing Measurement Data section below.

Option 5 - This option presents help information about the main meru.

Option 6 - This terminates execution of the user interface. If a measurement session was specified it will prompt the user with the following instructions:

```
TO BEGIN MONITOR EXECUTION
ENTER THE FOLLOWING VAX/VMS COMMAND
$SUBMIT/NOLOG FILE [DBMON]DBMONINIT
```

This command will submit the performance monitor into the batch job queue. The monitor will run according to the specifications the user provided. If a monitor session was

not established, the following informative message is

displayed:

NO MONITOR SESSION ESTABLISHED

If at any time during the execution of the user interface an

incorrect instruction is entered, the message - SELECTION

INVALID -- PLEASE TRY AGAIN - will be displayed. For any

reason the user interface may be aborted by using the CTRL C

sequence with no ill effects.

Specifying a Measurement Session

Specifying a measurement session involves the

successful completion of the following steps:

(1) Selecting a performance parameter set.

(2) Specifying performance tool parameters.

(3) Selecting data analysis option.

(4) Selecting data presentation option.

(5) Verifying selected options and entered data.

The following paragraphs describe the steps listed above in

greater detail.

Selecting a performance parameter set. This is done by

selecting from the Parameters Menu:

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```
1..MEASURE ALL PARAMETERS
2..MEASURE SOFTWARE ENGINEER'S SUBSET
3..MEASURE DBA'S SUBSET (DETAILED VIEW)
4..MEASURE SYSTEM MANAGER'S SUBSET
5..MEASURE DBA'S SUBSET (HIGH LEVEL VIEW)
6..MEASURE DBMS DESIGNER'S SUBSET
7..SELECT A SPECIALIZED SUBSET
8..HELP FOR THIS MENU
9..RETURN TO MAIN MENU
```

Option 1 - selects all possible parameters for measurement.

Option 2 through 6 - selects predefined parameter sets.

Option 7 - allows a special subset to be defined.

Option 8 - displays help information for Parameters menu.

Option 9 - cancels the request for a measurement session and

returns the user to the main menu.

Enter Data Specifying Performance Tool Parameters.

This data is used to specify session control information.

This is done with six data entry prompts. Each explains its

purpose, the required format, provides a sample entry, and

has a default value. The prompts include, session name,

session start date, stop date, start time, stop time, and

data collection interval.

Select a Data Analysis Option. The following Data

Analysis Menu is used:


```
1..STANDARD ANALYSIS
2..RETURN TO MAIN MENU
```

Option 1 - selects the data analysis performed by the VAX

utilities. This has been predefined, so this menu exists to

provide for any future expansion of the monitor.

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Option 2 - cancels the request for a measurement session and
returns the user to the main menu.

Select a Data Presentation Option. The Data
Presentation Menu is used to select this option:

  1..PRINT MEASUREMENT REPORT
  2..RETURN TO MAIN MENU

Option 1 - produces the measurement report that can be then
printed on the system printer.

Option 2 - cancels the request for a measurement session and
returns the user to the main menu.

Verify the Selected Menu Options and Entered Data.
This section displays the just entered session information
and prompts the user with:

  DO YOU WISH TO CHANGE ANY INFORMATION (Y/N) >

If the response is N, the command procedure and session log
files are created, and the user is returned to the main
menu. If the reponse is Y, the following Change Information
Menu is displayed:

  1..CHANGE MEASUREMENT SESSION NAME
  2..CHANGE START DATE
  3..CHANGE START TIME
  4..CHANGE STOP DATE
  5..CHANGE STOP TIME
  6..CHANGE DATA COLLECTION INTERVAL
  7..REDISPLAY SESSION INFORMATION

Options 1 through 6 - allow that item to be reentered using the same procedures as it was originally entered with.

Option 7 - returns to the Measurement Information Screen where more changes may be selected or control may be directed back to the main menu.

Analyzing Measurement Data

Option 4 of the Main Menu brings up the Performance Data Analysis Menu:

    1..VIEW MEASUREMENT DATA
    2..VIEW INSTRUMENT DATA
    3..PERFORM REPORT LIBRARY OPERATIONS
    4..HELP FOR THIS MENU
    5..RETURN TO MAIN MENU

Option 1 - allows the system performance parameter data collected during a measurement session to be examined.

Option 2 - allows the data collected by the instrumentation utility to be examined directly, and graphically presented.

Option 3 - allows the storage, retrieval, or deletion of performance report files into/from the performance report library.

Option 4 - displays help information for this menu.

Option 5 - returns the user to the main menu.

These options are discussed in greater detail in the following sections.

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Viewing Measurement Data

This section allows the examination of the measurement report produced by the last measurement session. Upon selecting option 1 of the Performance Data Analysis Menu, the following menu is presented:


```
1..VIEW SESSION INFORMATION
2..VIEW EFFECTIVENESS DATA
3..VIEW EFFICIENCY DATA
4..HELP FOR THIS MENU
5..RETURN TO DATA ANALYSIS MENU
```

Option 1 will display the measurement session specifications that were used in the preparation of the current measurement report.

Option 2 will display a menu that allows the user to view productivity, response, integrity, and security data from the measurement report.

Option 3 will display a menu that allows the user to view allocation, utilization, memory, IO, channel, device utilization, queueing, or deallocation data from the measurement report.

Option 4 will display menu help information.

Option 5 returns control to the Data Analysis Menu.

Viewing Instrument Data

This area allows the user to examine measurement data collected by the instrumentation utility. It provides direct examination, graphical representation, and

statistical analysis.

Upon selecting option 2 of the Performance Data
Analysis Menu, the following Instrument Analysis Menu is
displayed:

```
1..VIEW INSTRUMENT INFORMATION
2..VIEW INSTRUMENT UTILITY DATA
3..DISPLAY INSTRUMENT DATA GRAPHICS
4..PERFORM STATISTICAL OPERATIONS
5..HELP FOR THIS MENU
6..RETURN TO DATA ANALYSIS MENU
```

Option 1 selection will cause the display of instrument
session information listing the data bases that were
accessed, and the name of the DBMS application program.
Option 2 will display a menu that will allow the display of
DML response, utilization, IO, and memory data from the
instrumentation utility report.
Option 3 will allow the graphical representation of
instrument data. Paragraph Instrument Data Graphics
dicusses the details below.
Option 4 allows for the statistical analysis of instrument
data. Paragraph Instrument Statistics further discusses
this option.
Option 5 displays menu help information for the Instrument
Analysis Menu.
Option 6 returns program control to the Data Analysis Menu.

Instrument Data Graphics. Selection of Option 3 of the
Instrument Analysis Menu will present the following menu:

```
1..DML RESPONSE TIMES
2..DML CPU USAGE
3..DML BUFFERED IO
4..DML DIRECT IO
5..DML PAGE FAULTS
6..DML WORKING SET
7..RETURN TO INSTRUMENT ANALYSIS MENU
```

Options 1 through 6 will present a bar graph displaying the

frequency of the requested measures broken into eight

equally sized groups.

Option 7 will return control to the Instrument Analysis

Menu.

The data elements that make up the eight bars on the

graph may be examined with an interactive INGRES command.

From left to right the eight bars are numbered 1 through 8.

The following INGRES data base file names correspond to the

six DML parameters:

```
        PARAMETER              INGRES FILE NAME
DML RESPONSE TIMES             RESPTIME
DML CPU USAGE                  CPU
DML BUFFERED IO                BUFIO
DML DIRECT IO                  DIRIO
DML PAGE FAULTS                PGFLTS
DML WORKING SET                WSIZE
```

The following command is an example of the command required

to examine what DML is in a particular bar on the graph.

This command will list the DML instructions that had the

highest response times:

```
RANGE OF R IS RESPTIME
PRINT RESPTIME WHERE R.POSITION=8
```

Instrument Statistics. This option will allow two
statistical data files to be compared with the Wilcoxon
Rank-Sum Test. Upon selection of option 4 of the Instrument
Analysis Menu, the user will be presented with the
Instrument Statistics Menu:


```
  1..ENTER STATISTICAL FILE NAMES
  2..SELECT ALPHA LEVEL (DEFAULT IS .01)
  3..SELECT STATISTICAL PARAMETER AND PERFORM TEST
  4..DELETE STATISTICAL FILE
  5..HELP FOR THIS MENU
  6..RETURN TO INSTRUMENT ANALYSIS MENU
```


Option 1 will prompt the user for the names of the two
statistical files that are to be compared. Theses file
names must be the same as those specified during their
creation by the ANALDATA Program.

Option 2 presents the following menu:


```
  1..ALPHA =  .01
  2..ALPHA =  .05
```


where options 1 and 2 allow the user to specify what alpha
level the statistical test is to assume.

Option 3 presents the follwing menu:


```
  1..DML RESPONSE TIMES
  2..DML CPU USAGE
  3..DML BUFFERED IO
  4..DML DIRECT IO
  5..DML PAGE FAULTS
  6..DML WORKING SET
```

7..RETURN TO INSTRUMENT ANALYSIS MENU

where options 1 through 6 will perform the statistical

comparison of the selected parameter using the two files

previously specified with the specified alpha level, and

indicate to the user if there is a statistical difference

between the two files with regard to the selected files.

Option 7 returns control to the Instrument Analysis Menu.

Option 4 allows the user to delete previously created

statistical analysis files.

Option 5 provides menu help for the Instrument Statistics

menu.

Option 6 returns the user to the previous menu.

Performing Report Library Operations

This section allows the user to store measurement

reports into a library, retrieve them when needed, and

delete the reports that are no longer required.   Upon

selecting option 3 of the Performance Data Analysis Menu,

the following Menu is displayed:

   1..LIST LIBRARY ENTRIES
   2..STORE REPORT IN LIBRARY
   3..RETRIEVE REPORT FROM LIBRARY
   4..DELETE REPORT FROM LIBRARY
   5..HELP FOR THIS MENU
   6..RETURN TO ANALYSIS MENU

Option 1 displays the contents of the INGRES table that

maintains the report library index.   This allows the user to

determine what reports are stored in the report library.

Option 2 will allow the user to store a performance report in the library. The user is prompted for the title of the report to be stored, the date of the report, and the VMS filename where the report is currently residing.

Option 3 will prompt the user for the title and date of a report in the library, and also a legal VMS filename which is to contain the report obtained from the library.

Option 4 will delete a report in the library after prompting for the report title and date.

Option 5 displays menu help information for the Report Library Menu.

Option 6 returns control to the Analysis Menu.

The title and date of the report must be unique for each report. They are the identification that the library uses to keep track of the reports. The title may be up to 40 characters in length, and is intended to be descriptive of the contents of the reports. The reports that are intended for storage are INSTRUTIL.DAT, the instrumentation report, and DATAFILE.DAT, the raw instrumentation data, and PRINTER.DAT, the measurement report. When retrieving these reports, they should be placed into the appropriate VMS filename so that the User Interface will be able to display the retrieved reports. The contents of the report library may be viewed by executing the following interactive INGRES

command.

    PRINTR DBMONLIB LIBRARY

Analdata Operational Instructions

    Upon completion of the performance measurement session,
the following VMS command must be executed in order to
consolidate the raw instrument data files into one file:

  $COPY INSTR.DAT;* DATAFILE.DAT

Now the Data Analysis program must be executed. This is
accomplished by first entering the following VMS command:

  $RUN ANALDATA

This program will first display the following menu:

  1..ANALYZE TOTAL DATA
  2..ANALYZE INGRES DATA
  3..EXIT PROGRAM (NO ANALYSIS)

Option 1 specifies that the data to be analyzed is TOTAL
DBMS measurement data.

Option 2 specifies that the data to be analyzed is INGRES
DBMS measurement data.

Option 3 stops execution of the Data Analysis Program.

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If either option 1 or 2 is selected, the user is then prompted for a yes or no response to determine if a statistical analysis file is to be created. If yes, then the user is prompted for an up to nine character filename that will identify the statistical analysis file. If no, the analysis of instrumentation data continues without the creation of a statistical analysis file. During the analysis, this informative message is displayed:

ANALYSIS IN PROGRESS

If a statistical file was to have been created, then upon program termination, the user specified filename is confirmed with an informative message to the user.

ANALDATA also automatically produces the graphical analysis files. The last execution of ANALDATA will be reflected in the graphical data that can be viewed in the DBMON Program.

After execution of the ANALDATA program, the following VMS instruction must be entered:

@SORTINSTR.COM

This instruction will produce the SORTOUT.DAT file which the DBMON interface program uses to display the Instrument Report.

Use of the Instrumentation Facility

The Instrumentation Utility is a set of external procedures written in in VAX MACRO-11 Assembly Language. Calls to these subroutines are embedded into DBMS application programs before and after each DBMS command that is to have its performance recorded.

Any application program that is to be measured by the DBMON system will have to be modified to include the (1) declaration of three external procedures, (2) placement of calls to these procedures, and (3) recompilation of the application program. The required calls are described in the following sections.

1. Initutility - This procedure initializes the instrumentation utility and creates a data file for the recording of performance parameter values. This procedure is typically called once before the TOTAL sign on command, or just after the initial INGRES command. If this procedure is called again, it will cause the creation of a separate data collection file (INSTR.DAT). This provides the capability to tailor the contents of data files for use in specific performance tests. The format of this command is:

INITUTILITY(DBMSNAME,PROGRAMNAME,DBNAME,STATUS)

where DBMSNAME is either 'TOTAL ' or 'INGRES', PROGRAMNAME

is the name of the application program, DBNAME is the name
of the data base, and STATUS is the completion status of the
INITUTILITY procedure. The first three parameters are
Pascal string input parameters to the procedure. They may be
either declared varaibles or literals. STATUS is an output
parameter and must be a declared variable.

    2. MEASUREDBMS - This procedure records the state of
the DBMS just prior to the execution of a DML command or
group of commands. This procedure call is placed just
before the TOTAL DATBAS call or any of the embedded INGRES
EQUEL commands. The format of this command is:

  MEASUREDBMS(DBMSFUNCTION,DBMSFILENAME,STATUS)

where DBMSFUNCTION is the name of the DML command,
DBMSFILENAME is the name of the database file, and STATUS is
the completion status. The input parameter may be string
varaibles or literals. STATUS must be a declared string
variable.

    3. ENDMEASURE - This procedure records the state of
the DBMS just after a DML command. This call should be
placed just after a TOTAL DATBAS call or an INGRES EQUEL
command. The format of this command is:

  ENDMEASURE(ENDCODE,STATUS)

where ENDCODE is an input parameter and STATUS is an output parameter. ENCODE may be a literal or declared variable. STATUS must be a declared string variable. ENDCODE may have one of two values: 'ENDDML' or 'ENDPRG'. ENDPRG is used when the last measurement has been made and denotes the end of the mesurement session. Another call to INITUTILITY would be required to use the Instrumentation Utility. ENDDML is used at all other times to denote the end of a DML command.

Status Codes. There are two possible status codes that are returned by the Instrumentation Utility calls. A successful completion code is denoted by the value '****'. An error condition is indicated by the value 'EROR'. An error condition will also disable the Instrumentation Utility, so a call to INITUTILITY will be required to reinitialize the utility.

Preparation of the Application Program. After the Instumentation Utility calls are embedded into the application program, the program must be recompiled. At this point the following LINK command must be used when a TOTAL application is being instrumented:

```
$LINK <program-name>,<dev>:[DBMON]INSTRUTIL, -
     <dev>:[TOTAL]NATDATBAS,NATBUF
```

When an INGRES application is being instrumented the following command is to be used:

```
LINK <program-name>,<dev>:[INGRES.LIBRARY]LIBQ/LIBRARY, -
     <dev>:[INGRES.LIBRARY]COMPATLIB/LIBRARY
```

Instumentation Utility Execution. When the
instrumented application program is run, it will record data
in the INSTR.DAT file. The Instrumentation Utility may be
used in a stand alone manner without using the DBMON
interface generated measurement session. All of the
INSTR.DAT files created during stand alone operation must be
merged by the following command:

```
COPY INSTR.DAT;* DATAFILE.DAT
```

When a measurement session is conducted through the DBMON
interface, this merging of data files will occur
automatically.

Instrumentation Utility Example. The following is an
example of the embedded Instrumentation Utility calls.

```
PROGRAM EXAMPLE(INPUT,OUTPUT);

TYPE BUFF4 = PACKED ARRAY [1..4] OF CHAR;
     BUFF5 = PACKED ARRAY [1..5] OF CHAR;
     BUFF6 = PACKED ARRAY [1..6] OF CHAR;
     BUFF15 = PACKED ARRAY [1..15] OF CHAR;

PROCEDURE INITUTILITY(%STDESCR DBMSNAME:BUFF6;
                      %STDESCR PROGRAMNAME:BUFF15;
                      %STDESCR DATABASENAME:BUFF6;
                      %STDESCR STATUS:BUFF4); EXTERN;

PROCEDURE MEASUREDBMS(%STDESCR DBMSFUNCTION:BUFF5;
                      %STDESCR DBMSFILENAME:BUFF4;
```

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```
                              %STDESCR STATUS:BUFF4); EXTERN;

PROCEDURE ENDMEASURE(%STDESCR ENDCODE:BUFF4;
                            %STDESCR STATUS:BUFF4); EXTERN;

PROCEDURE GETDATA;
PROCEDURE DATBAS(CALL PARAMETERS...);

BEGIN
   MEASUREDBMS(COMMAND,FNAME,STATUS);
   DATBAS(COMMAND,...,FNAME,...);
   ENDMEASURE('ENDDML',STATUS);
END;

BEGIN    (* MAIN PROGRAM *)
          .   .
               .
   INITUTILITY('TOTAL ','EXAMPLE            ',
                 'DEMODB',STATUS);
   GETDATA;
   ENDMEASURE('ENDPRG',STATUS);
END.
```

    <u>Legal DBMS Functions</u>. The DBMSFUNCTION parameters used

in the MeasureDBMS procedure are the DML commands used in

TOTAL and INGRES. All TOTAL DML commands are five charaters

in length, so TOTAL commands are specified in MeasureDBMS

just as they are used in DATBAS calls. INGRES DML commands

are of variable lengths, so the following five character

abbreviations must be used with INGRES applications of the

Instrumentation Utility.

INGRES EQUEL COMMAND	DBMON ABBREVIATION
ABORT	ABORT
APPEND	APEND
BEGIN TRANSACTION	BEGTR
COPY	COPY
CREATE	CREAT
DEFINE	DEFIN
DELETE	DELET
DESTROY	DESTR

```
END TRANSACTION         ENDTR
HELP                    HELP
INDEX                   INDEX
INTEGRITY               INTEG
PERMIT                  PERMI
RANGE                   RANGE
REPLACE                 REPLA
RETRIEVE                RETRV
SAVE                    SAVE
SAVEP                   SAVEP
SET                     SET
VIEW                    VIEW
```

DBMON Outputs

Execution of the DBMON system produces various files
and reports. Raw data files are listed below.

```
DBMSJOB.DAT            PERFORM.DAT
INSTR.DAT              SORTOUT.DAT
INSTRMNT.DAT           SYSERR.DAT
LOGFAIL.DAT            SYSTEM.DAT
LOGSRC.DAT          -  TOTAL.DAT
MONITOR.DAT
```

These files are analyzed and summarized to produce the
following report files:

```
INSTRUTIL.DAT - the instrumentation report
PRINTER.DAT - the measurement report
```

Either of these reports may be printed on the system
printers, or viewed by executing the DBMON interface
program.

SECTION III - DBMON User's Methodology

DBMON User's Methodology

Methodology can be defined as the synthesis of methods and tools. The Tool in this case is the DBMON system. DBMON and the methods of its application comprise a DBMON User's Methodolgy as shown in Figure E-2. This methodology consists of the following five phases:

1. Understand the System - This phase involves familiarization with the VAX 11/780 computer system, the TOTAL and INGRES DBMSs, and the DBMS application being studied.

2. Identify Problem Areas - This phase involves analyzing the use of a DBMS to identify any potential problem areas that need to be addressed. This phase could also involve making and storing benchmark measurements against which to guage any future performance degredations.

3. Formulate a Performance Improvement Hypothesis - Once familiar with the system, and having identified a problem area, possible performance improvement hypothsis can be listed. These hypothesis should be analyzed to see if they are feasible. Unrealistic solutions to performance problems should be rejected at this stage.

4. Test Performance Improvements - This stage involves the design, implementation, and analysis of an experiment.
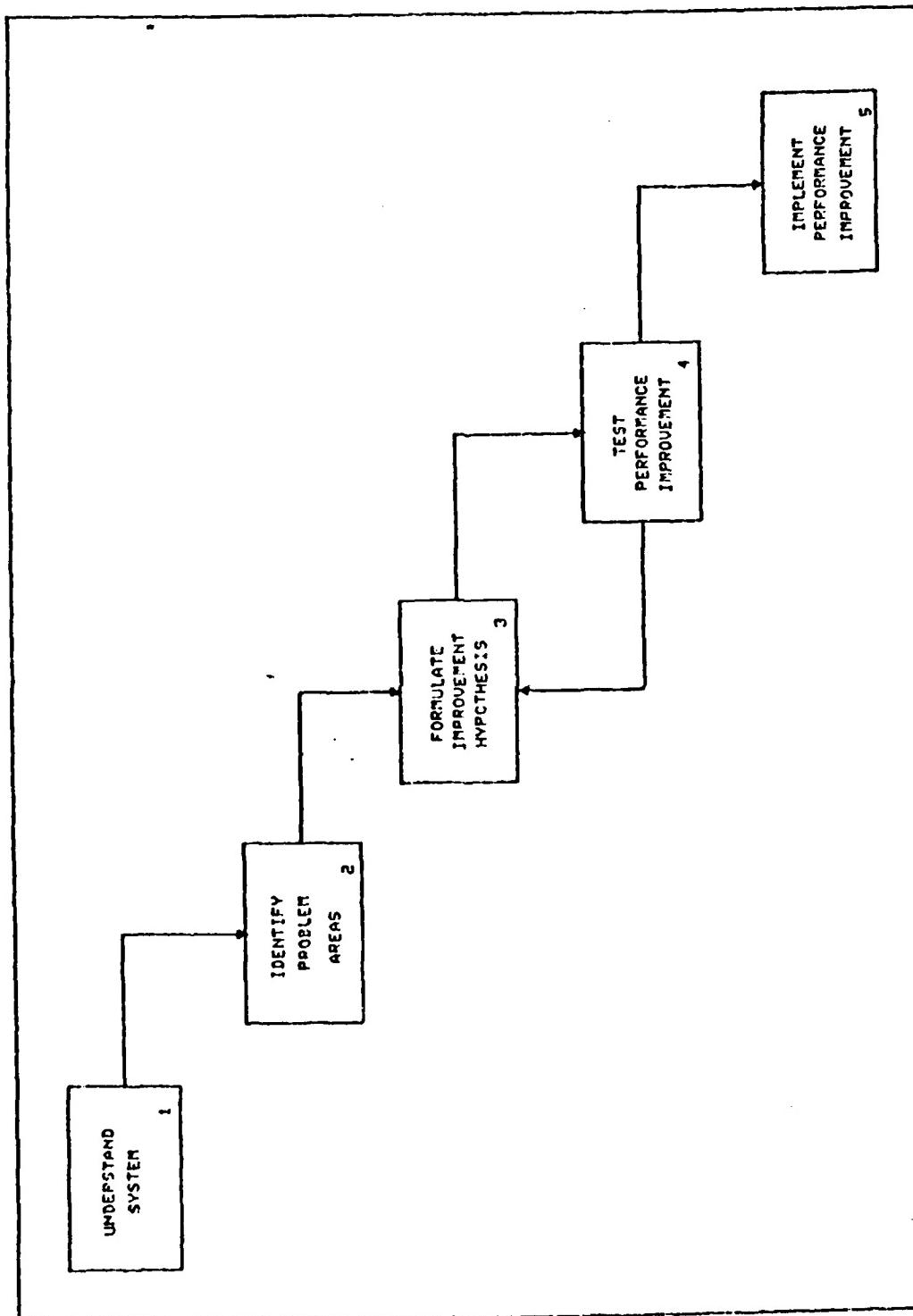
Figure E-2 DBMON USER'S METHODOLOGY

The hypothesis from phase four can be implemented and
statistically evaluated against the benchmark testing from
phase two.

5.   Implement Performance Improvement Modifications - The
statistical evaluation of phase four should indicate the
most effective modifications that can be made. In this
phase, the modifications should be installed and validated
for effectiveness and efficiency.

This methodology uses the DBMON system in phases two
and four. In phase two DBMON can be used to record
benchmark mesurement data. This can be done to identify
possible problem areas, or to maintain a historical record
of DBMS performance.against which to guage future DBMS
performance. This can allow the identification of long term
performance changes.

In phase four the DBMON system is used to record
measurement data after a change to the DBMS application or
its environment is made. A statistical comparison between
the new measurements and the benchmark made during phase two
will allow the DBMS analyst to determine if the improvements
made are of any performance value.

Experimental Procedure

With the identification of a possible DBMS performance problem, an experiment may be conducted to determine if a solution is possible. The following steps need to be taken:

(1) Instrument the application program.

(2) Set up and execute a monitor session while running the application program.

(3) Analyze the resulting data, and create a statistical analysis file.

(4) By examining the analyzed performance data, formulate a performance improvement hypothesis.

(5) Implement the performance improvement.

(6) Set up and execute a monitor session while running the application program with the improvement modifications made.

(7) Analyze the newly collected performance data, and produce a statistical analysis file.

(8) Compare the two statistical analysis files to

determine if the performance improvement modifications are
statistically significant.

Following this application of the DBMON User's Methodology
can result in a solution to a performance problem if one
exists. The DBMON system is only a tool towards this end,
the key factor in this process is the ability to identify
the cause of the DBMS performance problem and to find a
solution.

Appendix F

Test Plan Results

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F-1

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2 - Perform the necessary statistical and/or graphical analysis.

TEST CASES:

1. No analysis requested.
2. One specific analysis requested.
3. All possible analysis requested.

EXPECTED RESPONSE:

1. No analysis performed.
2. Requested analysis performed.
3. All possible analysis performed.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____ DATE:20 AUG 85
CASE 2. - PASS:__X__ FAIL:_____ DATE:20 AUG 85
CASE 3. - PASS:__X__ FAIL:_____ DATE:20 AUG 85

REMARKS: No problems encountered.

REQUIREMENT: 3.2.1 - Allow the user to specify statistical tests to be performed on the measurement data.

TEST CASES:

1. No test is requested.
2. One specific test is requested.
3. All possible tests are requested.

EXPECTED RESPONSE:

1. No analysis is scheduled.
2. Requested analysis is scheduled.
3. All possible analysis is scheduled.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____   DATE:20 AUG 85
CASE 2. - PASS:__X__ FAIL:_____   DATE:20 AUG 85
CASE 3. - PASS:__X__ FAIL:_____   DATE:20 AUG 85

REMARKS: No problems encountered.

REQUIREMENT: 3.2.2 - Allow the user to specify graphical
representations to be made of the measurement data.

TEST CASES:

1. No graphical representation is requested.
2. One graphical representation is requested.
3. All possible graphics are requested.

EXPECTED RESPONSE:

1. No graphics are scheduled.
2. Requested graphics is scheduled.
3. All possible graphics are scheduled.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____   DATE:25 AUG 85
CASE 2. - PASS:__X__ FAIL:_____   DATE:25 AUG 85
CASE 3. - PASS:__X__ FAIL:_____   DATE:25 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 3.2.3 - Create output files of statistical and graphical analysis data.

TEST CASES:

1. No statistical/graphical analysis is requested.
2. Some statistical/graphical analysis is requested.

EXPECTED RESPONSE:

1. No output files are created.
2. A statistical/graphical output file is created.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____   DATE:15 AUG 85
CASE 2. - PASS:__X__ FAIL:_____   DATE:15 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.4 - Display graphical presentations of the
specified performance measurement data.

TEST CASES:

   1. No graphical representation was requested.
   2. One graphical representation was requested.
   3. All possible graphics were requested.

EXPECTED RESPONSE:

   1. No graphics are displayed.
   2. One graphical representation is availble for display.
   3. All possible graphics are availible for display.

RESULTS:

   CASE 1. - PASS:__X__ FAIL:_____   DATE:25 AUG 85
   CASE 2. - PASS:__X__ FAIL:_____   DATE:25 AUG 85
   CASE 3. - PASS:__X__ FAIL:_____   DATE:25 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5 - Allow the user to maintain historical performance measurement data.

TEST CASES:

1. No library maintenance requested.
2. Library maintenance activity is requested.

EXPECTED RESPONSE:

1. No library activity is undertaken.
2. Requested library function is performed.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____ DATE:10 AUG 85
CASE 2. - PASS:__X__ FAIL:_____ DATE:10 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.1 - Allow the user to store performance
reports in a library.

TEST CASES:

1. No storage of reports is requested.
2. Library storage is requested.

EXPECTED RESPONSE:

1. No report storage occurs.
2. A performance report is stored in the library.

RESULTS:

CASE 1. - PASS: X FAIL:____   DATE:10 AUG 85
CASE 2. - PASS: X FAIL:____   DATE:10 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.2 - Allow the user to retrieve performance
reports from a library.

TEST CASES:

   1. No retrieval of reports is requested.
   2. Library retrieval is requested.

EXPECTED RESPONSE:

   1. No report retrieval occurs.
   2. A performance report is retrieved from the library.

RESULTS:

   CASE 1. - PASS:__X__ FAIL:_____   DATE:10 AUG 85
   CASE 2. - PASS:__X__ FAIL:_____   DATE:10 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 4.5.3 - Allow the user to delete performance
reports from a library.

TEST CASES:

1. No deletion of reports is requested.
2. Library deletion is requested.

EXPECTED RESPONSE:

1. No report deletion occurs.
2. A performance report is deleted from the library.

RESULTS:

CASE 1. - PASS:__X__ FAIL:_____ DATE:10 AUG 85
CASE 2. - PASS:__X__ FAIL:_____ DATE:10 AUG 85

REMARKS: No problems encountered.

TEST PLAN RESULTS FOR FOR A DBMS PERFORMANCE MONITOR

REQUIREMENT: 5.0 - Have all operating instructions and
procedures in a comprehensive user's manual.

TEST CASES:

   1. Manual represents all the operating instructions for
the performance monitor.

EXPECTED RESPONSE:

   1. The manual is complete in its coverage of monitor
operations.

RESULTS:

   CASE 1. - PASS:__X__ FAIL:_____   DATE:15 SEP 85

REMARKS: *No problems encountered.*

Appendix G

DBMON Problem Report Form

Table of Contents

Introduction

This appendix contains the problem report form that is to be used to bring software problems to the attention of the Information Sciences Laboratory.

DBMON PROBLEM REPORT FORM

TO: AFIT/ENG ISL

FROM:_____

Problem Report Number:_____

Date:_____

Problem
Name:_____

Program(s) Having
Problems:_____

Problem
Description:_____

_____

_____

_____

_____

_____

Degree of Problem
Seriousness:_____

_____

Difficulty of
Fix:_____

_____

Suggestions for
Fix:_____

_____

_____

Disposition:_____

END

12-86
DTIC